Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

JANUARY, 1960

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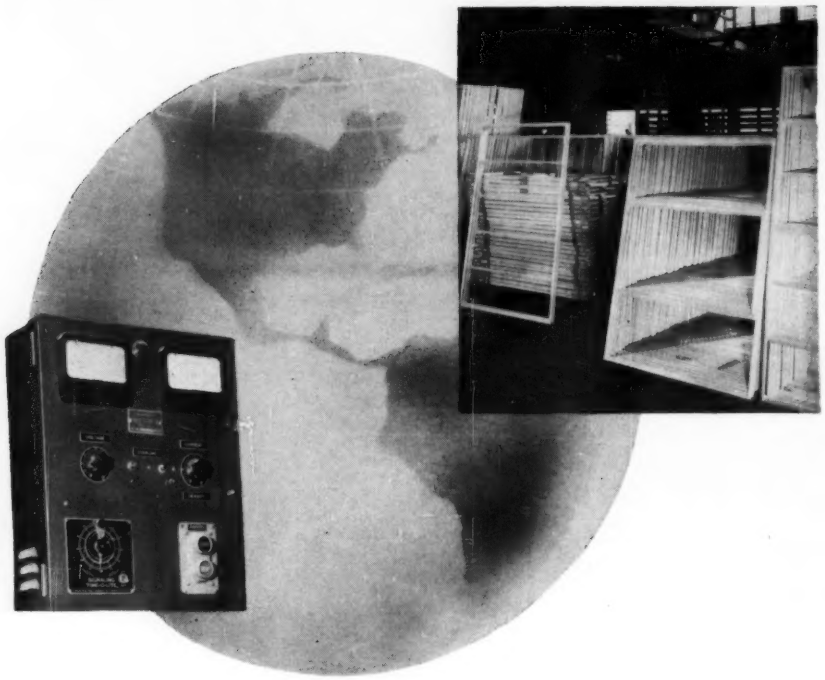
Read and pass on—



"There's a world of difference in Anodizing when you have Automatic Current Control" . . .

. . . says John Gurniak of

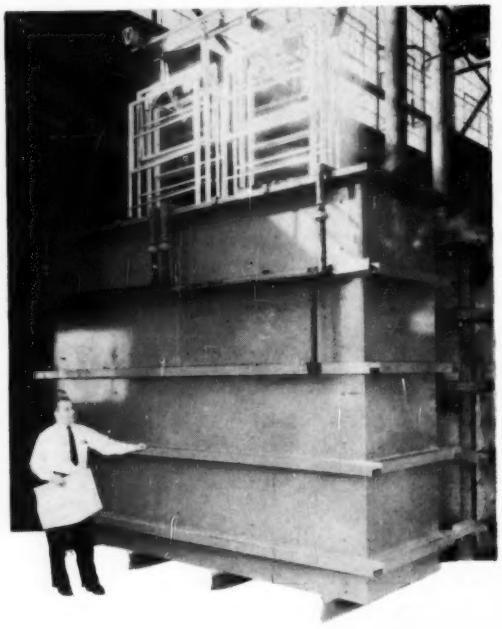
MICHAEL FLYNN MFG. CO., PA.

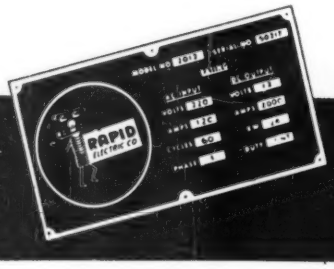
"and that big difference is the accuracy and simplicity in which a pre-determined film thickness can be controlled."

"We chose RAPID ELECTRIC'S Automatic Current Control rectifiers to eliminate the problem of estimating current densities with each load change. One setting, and the rectifier automatically maintains a constant current density per square foot of work."

"It's that easy".

"Once more, with the possibility of over-current virtually eliminated, MICHAEL FLYNN'S high standard of quality is assured."



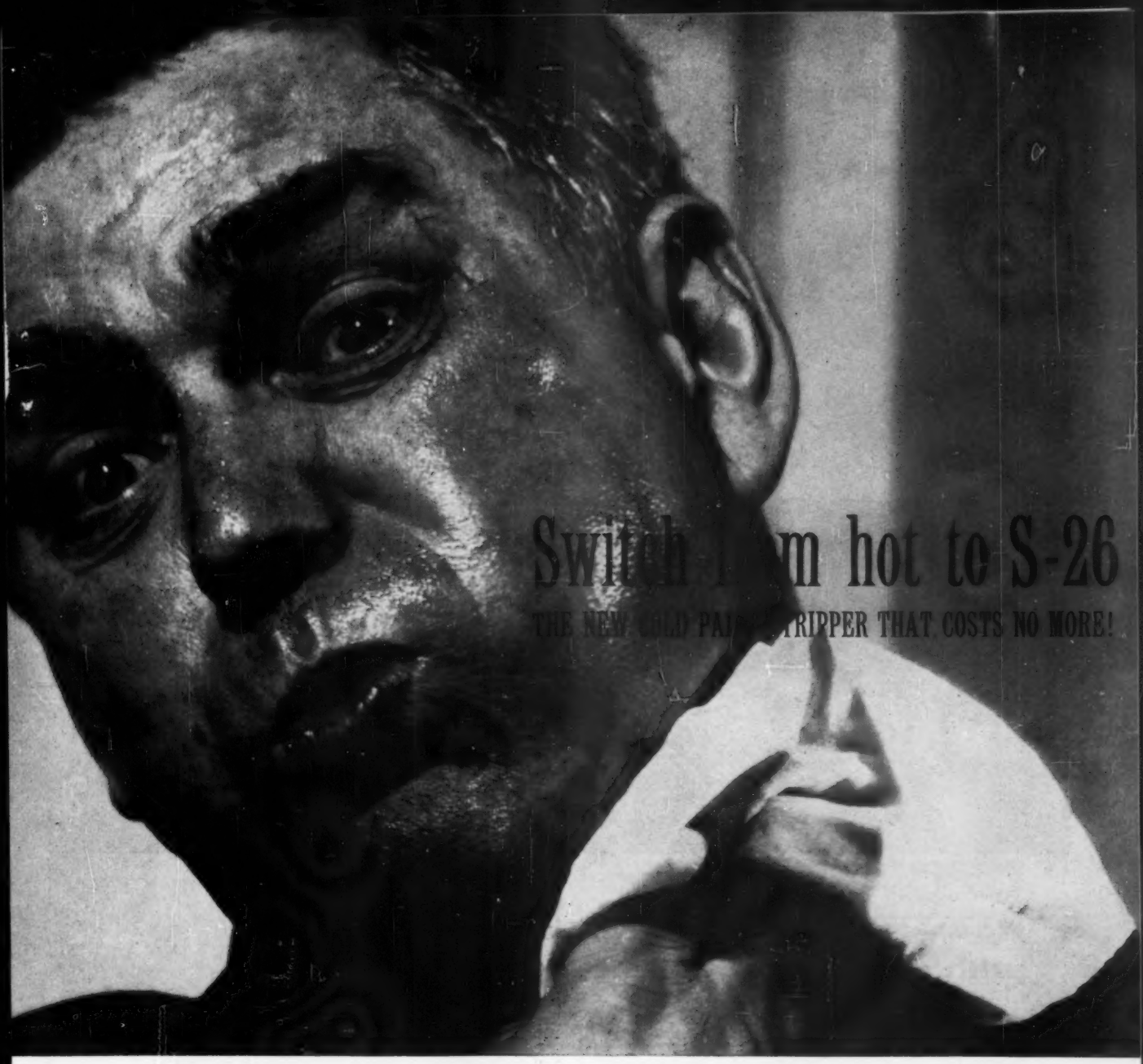


THE NAMEPLATE THAT MEANS *"More Power to You!"*

RAPID ELECTRIC COMPANY

12838 Fenkell Avenue • Detroit 27, Mich. • Diamond 1-8537

2881 Middletown Road • New York 61, N. Y. • TAlmadge 8-2200



Announcing a chlorinated paint stripper which can be diluted with up to 20 parts by volume of water to form clear effective stripping solutions. Enthone Stripper S-26 will remove epoxy and other synthetic enamels at room temperature—at a make-up cost per gallon less than that of many hot paint strippers!

Stripper S-26 is an acidic, non-flammable chlorinated product, miscible with water in almost all proportions. If you now use conventional, undilutable chlorinated strippers, you can cut your paint stripper consumption at least 84% by using Stripper S-26 at a dilution ratio of 1 part stripper to 6 parts water by volume. At this dilution ratio, Stripper S-26 will readily wrinkle off modern, hard-to-strip epoxies from steel, aluminum, copper, brass and zinc die castings. Because of the large volume of water present in the made-up stripping solution, evaporation losses are much less than with undiluted cold strippers.

Get all the facts right now about economical, cold paint stripping by calling your Enthone representative for a demonstration of Stripper S-26. Or write to Enthone, Inc., 442 Elm Street, New Haven, Connecticut, for complete literature.

ASARCO

ANOTHER PRODUCT OF Enthonics RESEARCH

ENTHONE

A Subsidiary of American Smelting and Refining Company

For a pre-cleaning short-cut to better plating

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

Now—remove smut, rust and soils with one electrocleaner: Oakite 190

Here is a new reverse-current cleaner that performs two operations at once. (1) It removes the oily soils normally requiring an alkaline cleaner . . . and (2) it removes smut and rust bloom normally requiring additional treatment.

New Oakite 190 performs this double duty because it's a *chelated* detergent. Chelation—which makes metallic salts and oxides soluble in water—handles the removal of smut, heat scale and rust. Powerful alkaline detergency handles the removal of oil films and shop soil. As a bonus, Oakite 190 has high conductivity, rinses well in hot or cold water.

Result: new Oakite 190 insures fewer plating rejects due to inadequate pre-cleaning, *eliminates an entire operating step* in many instances.

For more details about Oakite 190, ask your local Oakite man or write to Oakite Products, Inc., 18 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

50 *1909-1959* SCIENCE

years' leadership in industrial cleaning

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SECOND CLASS POSTAGE PAID at the Post Office in Westwood, N. J. and New York, N. Y. Volume 58, No. 1, January, 1960. Five dollars per year.

61 . . . . for 61 years!

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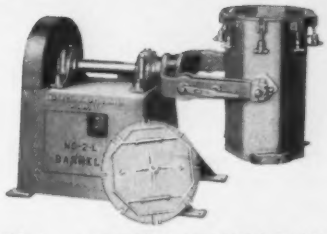
Chas. F. L'Hommedieu & Sons Co.

No. 18 — VARIABLE SPEED POLISHING LATHE

Independent spindles—each with separate patented Variable Speed Drive and controls — ball-bearing throughout. Powered by two up to 25 H.P. motors. Adopted by leading manufacturers as standard equipment.



TYPE L — DOUBLE ACTION BARREL
For ABRASIVE TUMBLING or BALL BURNISHING

The cylinder can be operated at an angle for producing a double tumbling action—thus producing a better and more uniform finish in a much shorter time.

Longer pieces finished more uniformly and without bending.

RELIANCE KUL-KUT BUFFS
FOR FAST CUTTING

RELIANCE EXTRUDED COMPOSITIONS

STANDARD SIZE
2 x 2 x 10"

THEY CUT • THEY CLEAN • THEY COLOR

- **DURABILITY**
- **PRODUCTION**
- **ECONOMY**
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THE ANSWER TO INCREASED PRODUCTION AT LOWER COST!

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SIZEWISE TIMEWISE MONEYWISE

You get your best buy with
H-VW-M ECON-O-SHAPE NICKEL ANODES

Designed to Save You Money. New H-VW-M Nickel Anodes retain efficient elliptical shape, but are made thicker to give you more weight per inch . . . 1.32 lbs. Standard anode bags fit . . . less scrap loss per anode too. Result: longer runs that save labor.

Pre-Cleaned, Ready for Use . . . H-VW-M Nickel Anodes are detergent-washed, reach you free of chips and grease . . . wrapped in waterproof, greaseproof paper. And H-VW-M supplies titanium hooks as well as monel.

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H-VW-M
Progress in metalfinishing through advanced processes • equipment

Some of the Many **CLEPO** Tumbling Compounds Available

HOW TO CHOOSE AN ABRASIVE TUMBLING COMPOUND

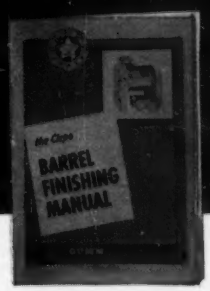
Whatever your abrasive tumbling application, here's how to select the exact compound to meet your requirements:

1. Choose from a broad line of compounds developed by barrel finishing specialists.

2. Have a barrel finishing expert work with you to assure top product performance in the application.

When you buy a CLEPO abrasive tumbling compound, you get both.

Special compounds for unusual requirements are designed in the Gumm testing and research laboratories and barrel tumbling pilot plant.



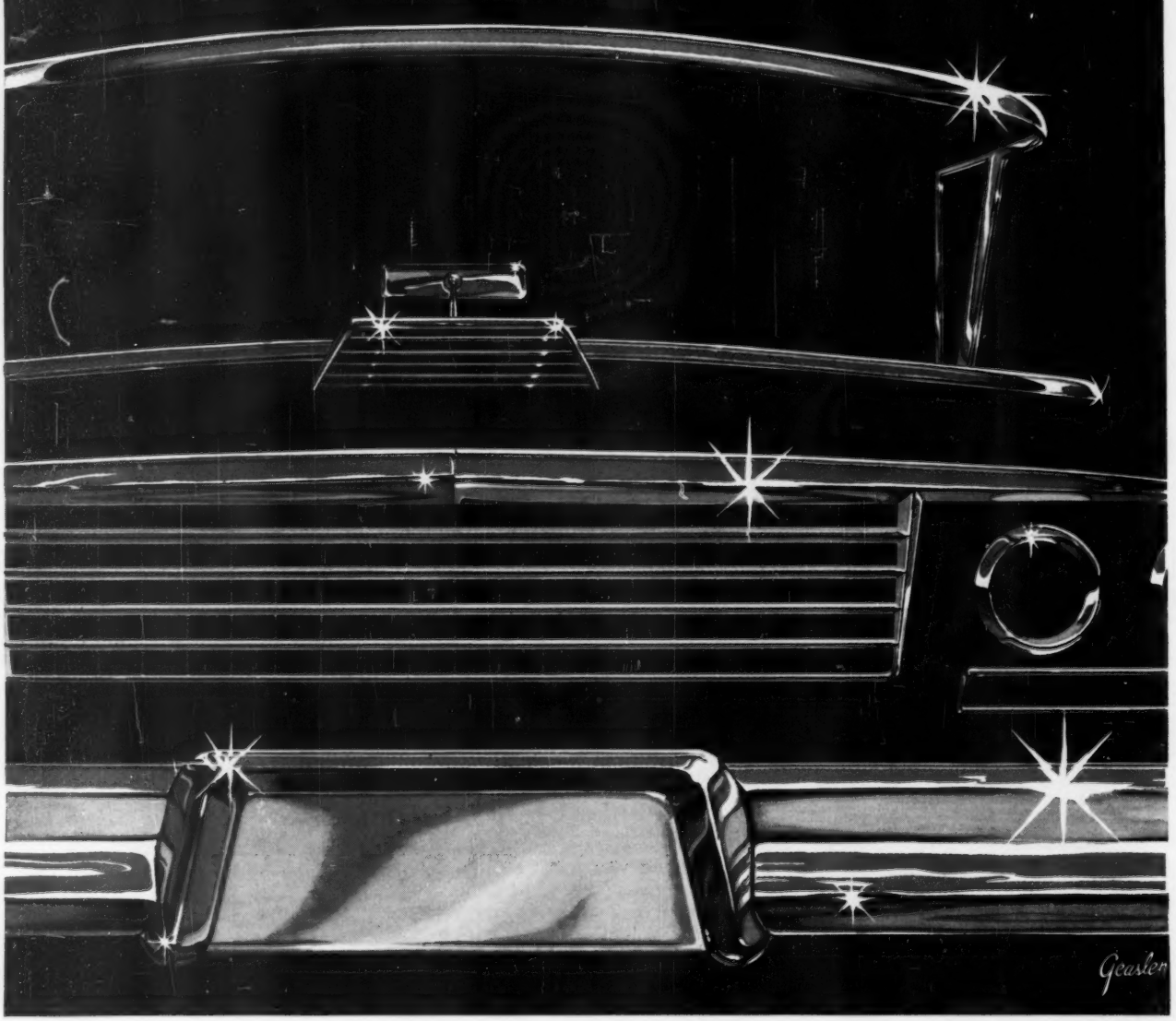
For complete data on barrel finishing, 20-page CLEPO Barrel Finishing Manual available on letterhead request.

CLEPO 171-A	For polishing hardened steels to produce extremely low microinch finish
CLEPO 14-W	For light cutting and removing fine burrs from brass or copper
CLEPO 14-R	For medium cutting and deburring of steel brass, copper
CLEPO 205-J	For fast cutting of the hardest steel and alloys
CLEPO 214-A	For long heavy grinding of sand castings and steel
CLEPO 19-D	For rough cutting steel to produce heavy matte finish

FREDERICK GUMM CHEMICAL COMPANY INC.
538 Forest Street, Kearny, N. J.

Harshaw Perflow-Perglow Duplex Nickel Plating Process
Continues to Make Startling Advances

now well over **one million**



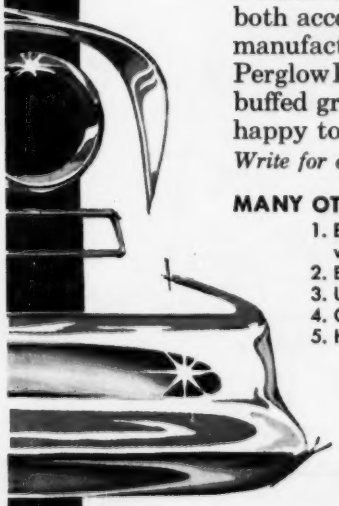
in operation

There is no more graphic way to demonstrate the superiority of this outstanding Harshaw development than to *state the facts:*

1. *ALL* 1959 domestic autos used external parts plated with Harshaw Perflow-Perglow Duplex Nickel (*On some models as high as 90% of the external parts.*)
2. Over Three Hundred Thousand gallons of Perflow-Perglow Duplex Nickel were installed between June 15 and September 15, 1959!

This is an amazing growth record, pointing up the undeniable fact that automobile manufacturers and their suppliers turn to the process which promises maximum corrosion resistance for their products—and in an ever-increasing wave they are turning to the Harshaw Perflow-Perglow Duplex Nickel Plating Process.

The Harshaw Chemical Company after years of research and development work was the first to find that a *sulfur-free* nickel offers greater corrosion resistance. This fact led to the development of the Harshaw Perflow nickel plating process. Further research showed that use of the sulfur-free Perflow nickel deposit as a base coating, followed by a bright nickel deposit from a *compatible* bath, would give a Duplex deposit with a further improvement of corrosion resistance. Performance data, by both accelerated tests and outdoor exposure, from leading automobile manufacturers and parts suppliers indicate that the Harshaw Perflow-Perglow Duplex nickel plate is comparable to and frequently better than, buffed gray nickel and is unequalled by any bright nickel. We shall be happy to discuss this process with you in person, or by phone or letter. *Write for our free booklet, "Harshaw's Complete Service to The Plating Industry."*



MANY OTHER ADVANTAGES

1. Exceptionally high plating speeds—with air or mechanical agitation.
2. Excellent Chrome Coverage.
3. Unsurpassed Leveling Characteristics.
4. Outstanding Brightness.
5. High Tolerance to Impurities.
6. Excellent Adhesion.
7. Excellent Ductility at Full Brightness.
8. Simplified Control—Stable over extended periods of operation.
9. Controlled Stress.
10. Uniform Protective and Decorative plate on both steel and zinc die castings.

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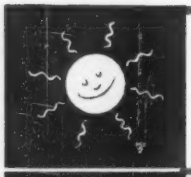
MICCRO PRODUCTS

improve your quality . . . increase your production



MICCROSOL

Today's outstanding heat-cured rack and tank coating. Meets industry's highest standards for corrosion and abrasion resistance.

MICCROSTOP

For extreme accuracy in masking parts for all plating cycles.

MICCROMASK

Provides complete masking protection for hard chromium plating.

MICCROPEEL

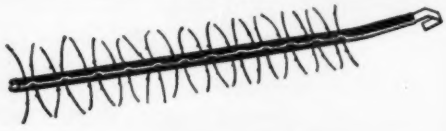
A special lacquer that can be peeled easily from parts after all plating cycles.

MICCROWAX

Two waxes widely used for selective stop-off. C-562 for hard chromium; C-600 for high-temperature cycles.

MICCROTEX

An air-dry rack coating for all plating cycles. Excellent for patching and repairing.

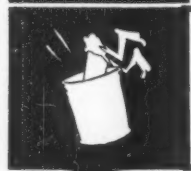


MICCROTAPE

An extruded tape which provides unexcelled protection for plating racks, and for masking parts prior to selective plating.

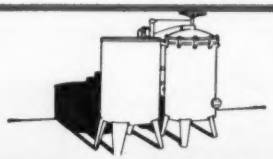
MICCROTUBE

Extruded tubing especially suited for use on contact wires, and for selective plating of simple parts.



MICCROLOID

Corrosion-resistant industrial maintenance paint.



MICCRO Products

Developed and manufactured by experienced platers and coaters

Write for particulars on company letterhead.

MICHIGAN CHROME *and Chemical Company*

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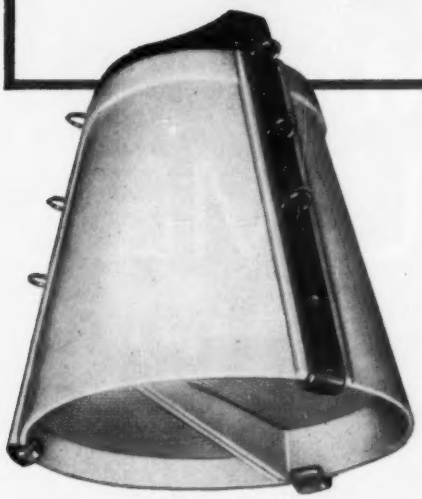
LIGHTER STRONGER LONGER LASTING



Here's Why Stevens Can Offer You a Barrel superior to anything else on the market today:

THE MATERIAL

Stevalite . . . tremendous impact strength . . . heat resistance to 270° F. 50% lighter than any other material.

THE DESIGN

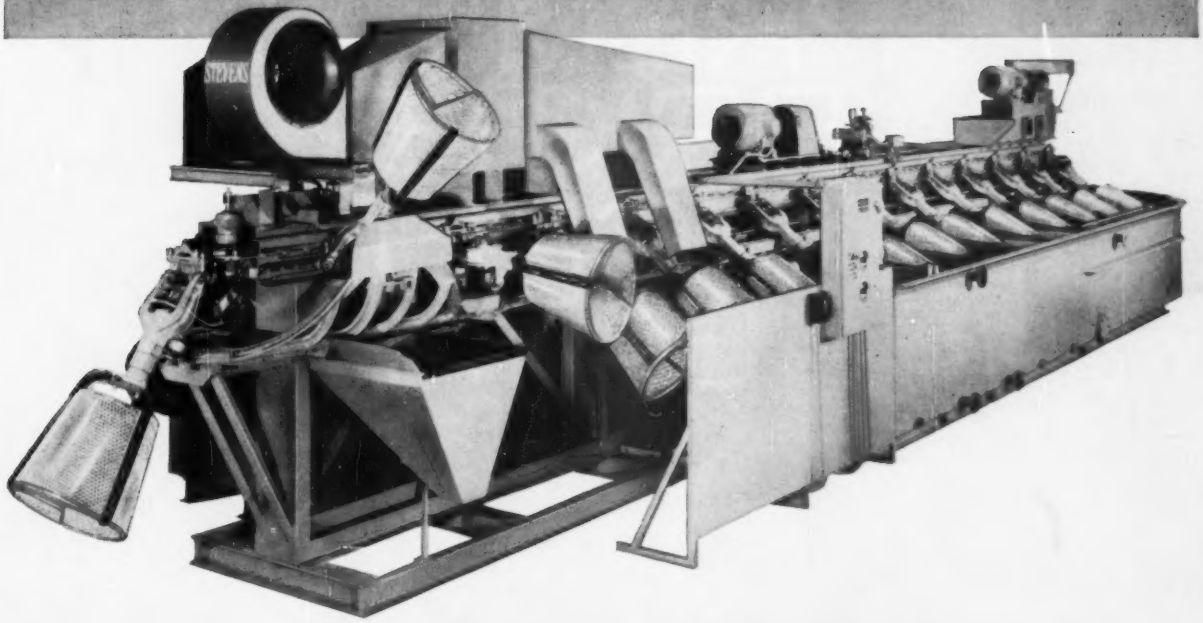
Oblique barrel tumbles parts more effectively giving improved plate distribution. Thinner wall decreases solution dragout. Dense perforation count boosts current draw and plating speed up to 30%. Faster drying.

THE CONSTRUCTION

Rigid, rugged *all welded* . . . unaffected by heat distortion . . . reinforced to resist damage. Minimum number of necessary parts.

You cannot buy a more efficient and productive barrel anywhere. Simple in conception and construction, it can guarantee you real maintenance-free performance and long productive life . . . the perfect barrel.

FOR USE ON ALL STEVENS AUTOMATIC BARREL PLATING-PROCESSING MACHINES



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DETROIT 16, MICH.

BUFFALO CHICAGO DETROIT CLEVELAND
DAYTON NEW HAVEN INDIANAPOLIS SPRINGFIELD (OHIO)

Remember **— When you go *automatic* . . . go STEVENS!**

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SUPERLUME

THE PREMIUM BRIGHT NICKEL BATH

H-VW-M

Progress in metal finishing through advanced processes • equipment

we admit it

There may be other baths as bright as H-VW-M Superlume

But

SUPERLUME

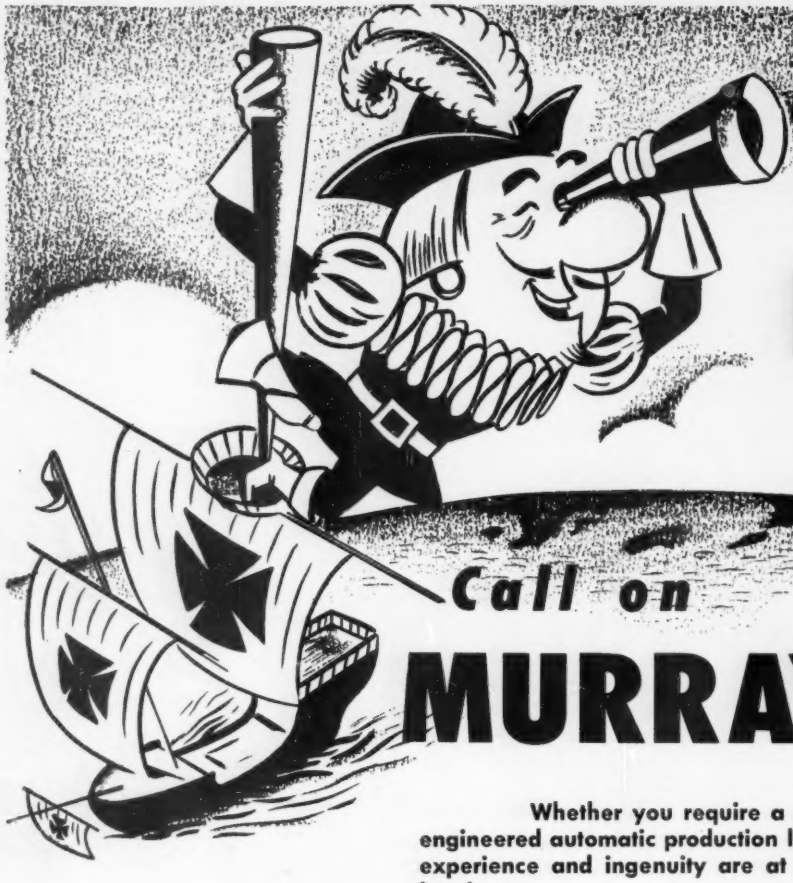
IS THE MOST DUCTILE AT HIGHEST LEVELLING

SUPERLUME

LEVELS BEST

Sure, it costs a little more than conventional bright baths—but no more than other baths that are almost as good as fast plating Superlume. Why not get the best! Write or call for full details.

Hanson-Van Winkle-Munning Company, Marawan, New Jersey • Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco



Looking for

A BETTER WAY?

Call on

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Whether you require a standard unit or a completely engineered automatic production line, Murray-Way's engineering experience and ingenuity are at your service. We invite your inquiry.

POLISHING HEADS—A complete line. Wide or narrow wheel, abrasive belt, oscillating, overhead, pedestal mount, self-adjusting, with many special Murray-Way features.

MICRO-POLISH—The original flat polishing unit. Micro-finishes coil, strip or blanks before forming. Fast, accurate, economical. Saves money and rejects.

ROLLER COATERS—Coat one or both sides. Easy, micro adjustment; simple sturdy construction; shielded bearings; easily accessible rolls.

DIAL TABLES & CONVEYORS—Standard or specially engineered; constant or adjustable dwell; vertical or horizontal platen; single plane or over-and-under. Many unique Murray-Way features.

SEMI-MATIC POLISHING & BUFFING MACHINES—Highly versatile, low cost polishing and buffing equipment to fit any requirement. Handles a wide variety of sizes, shapes and finishes.

MURRAY WAY

MURRAY-WAY CORPORATION

P. O. BOX 180, MAPLE ROAD EAST • BIRMINGHAM, MICH.

Have you tried it yet?

Prove to yourself . . . on your own lathes, why so many finishers say that no other buff can compare with

the

AMERICAN FLAPPER

Call for a demonstration

American Buff Company

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CAlumet 5-1607

Suburban living
calls for versatile home fencing

like long lasting G & B Welded-Fence, finished with AHCO Compounds.

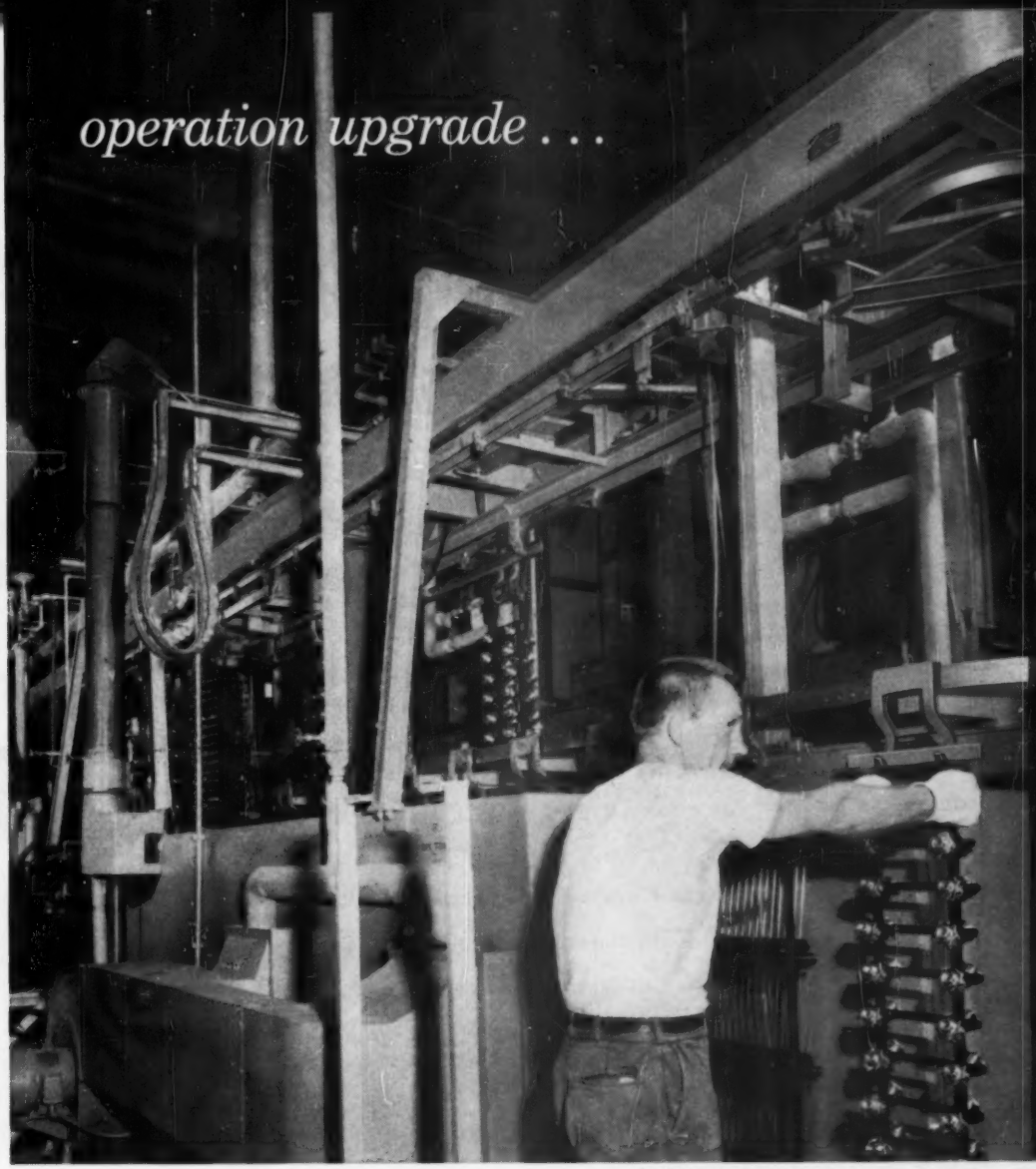
Around the yard or around the garden there's sure to be a job for G & B Welded-Fence or Flower Border. And this sturdy, attractive fencing costs less than the cheapest ornamental fence. No wonder sales to homeowners everywhere are mounting fast. To achieve longer fence life, to save time and labor, Gilbert & Bennett Manufacturing specifies Ahcoloid Metal Cleaners formulated especially for their finishing cycle.

Whatever you make, chances are good that you, too, can profit from the performance of one or more AHCO *custom* Compounds. We will be happy to show you how. Just write Apothecaries Hall Division, 28 Benedict St., Waterbury, Conn.

Hubbard Hall

THE
HUBBARD-HALL CHEMICAL
COMPANY
APOTHECARIES HALL DIVISION

operation upgrade . . .



Udylite Cyclemaster in operation at American Standard Plumbing and Heating Division, Cincinnati, Ohio

CYCLEMASTER has the answer . . .

This Udylite Cyclemaster, which is another way to say low cost automation, represents six important areas of improvement in American Standard's plating production.

- quality control to meet their most exacting top standards
- production volume far exceeding their expectations
- nearly 50% savings in floor space used for the operation
- almost total elimination of rejected pieces
- ultra-sonic cleaning to eliminate complicated de-greasing
- Plastisol coated tanks for minimum maintenance . . . long life

Learn how Cyclemaster can perform with equally promising revisions of your profit picture while improving your product whatever it may be. To find out how so *much* can be accomplished for so *little*, ask your Udylite representative, today!

the udylite corporation

detroit 11, michigan • world's largest plating supplier

on the west coast: the L. H. Butcher Company

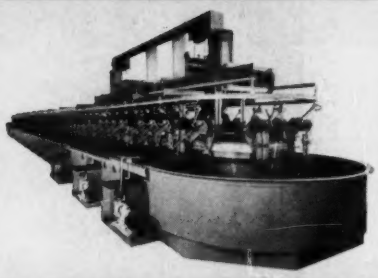
New machine for dipping processes...

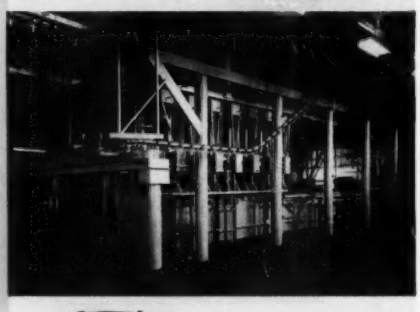
Crown "M-P" Multi-Purpose automatic processing conveyor

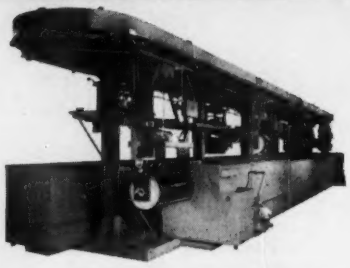
Crown M-P (Multi Purpose) Conveyors are a new development in basic design and control that brings automatic dipping processing to all industry for multi cycle processing in plating—anodizing—painting—phosphatizing and rubber dipping operations. Using the basic "M-P" concept, machines can be built to meet your specific requirements by incorporating one or several of these important Crown features:

- **Each carrier can be set for one of several different cycles.**
- **One machine that can plate two or three different metals.**
- **Horizontal and oblique barrels and even racks can operate on the same machine.**
- **Rack and barrel work can be plated at two different voltages on one machine.**
- **Work can be plated at four different thicknesses at the same time.**
- **Size of parts can vary from ¼ inch to 40 feet in length.**
- **Weight per station from ten to three thousand pounds.**
- **Lifts from 12 inches to 12 feet.**
- **Rotation, tilting, or other auxiliary motion during transfer.**
- **Machines of this type have been at work in actual production for over 2 years.**

Some typical "M-P" installations







CROWN

If your process includes a series of dips, you should know more about the Crown "M-P" . . . ask for our Bulletin M-P. Tell us your processing requirements and we will be glad to show you how the "M-P" can save you money.

CROWN RHEOSTAT AND SUPPLY COMPANY
1965 Pratt Boulevard • Elk Grove Village, Illinois

A NEW
BRIGHT NICKEL PROCESS

LEVELMAX

for excellent brightness, levelling, and ductility at low cost

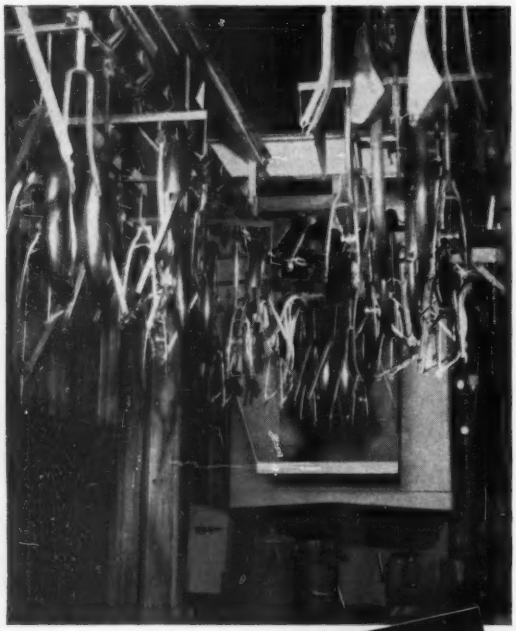
Now—for the widening use of nickel plating and the new plating problems brought about by the wider variety of shapes and base metals—ASARCO has developed a new process, simple to control and maintain. LEVELMAX will tolerate considerable organic and metallic contamination even with infrequent purification or treatment. Buffing and finishing of the base metal can often be completely eliminated. Hard-to-buff areas can be plated bright. The bright-nickel surface readily accepts chrome. Corrosion resistance is excellent. Maximum productivity is assured by high current densities which are successfully used with the LEVELMAX process. Conventional or air agitation can be used. Analytical procedures are provided for the determination of all constituents. Write for complete working details about the new LEVELMAX BRIGHT NICKEL PROCESS to Federated Metals Division of American Smelting and Refining Company, Electrochemicals Dept., 120 Broadway, New York 5, N. Y. In Canada, Federated Metals Canada, Ltd., Toronto and Montreal.

FEDERATED METALS DIVISION

ASARCO

FINISHING SYSTEMS...

Self-Housed Equipment Installed on Roof Saves Over 10,000 Sq. Ft. of Manufacturing Floor Space!



Over a period of twenty-three years the Mahon company has worked in close cooperation with Arnold, Schwinn & Co., manufacturers of famous Schwinn Bicycles, in developing finishing equipment which now produces what is acknowledged the highest quality finish, the most durable finish, and the finest appearing finish in the industry.

The three Finishing Systems installed by Mahon in the past twenty-three years have saved Arnold, Schwinn & Co. over 10,000 Sq. Ft. of valuable manufacturing floor space inside the company's two-story plant. In the first Finishing System, installed in **1936**, only the Spray Booths were located inside the plant; other units, including two Finish Baking Ovens together with Heating Equipment, Recirculating Fans, etc., were housed on the roof.

In **1950**, another complete self-housed Prime-Coat Finishing System, shown above, was installed in its entirety on the roof—the design being a two-level arrangement with Dry-Off Oven, Finish Baking Oven and Heating Equipment Room on the upper level. This System handles Cleaning, Rust Proofing and Prime Coating of all parts produced which receive their 2nd and 3rd or final coat in the other two Finishing Systems.

In **1956**, a third Finishing System was installed with 2nd Coat Finish Baking Oven, Cooling Area, 3rd or Final Coat Finish Baking Oven and Heating Equipment Room located on the Roof. Electrostatic Spray Booths for this System were located on the second floor of the plant directly below.

When you consider buying a new finishing system, or any unit of finishing or processing equipment, you, too, will want to discuss methods, equipment requirements and possible production layouts with Mahon engineers . . . you'll find them better qualified to advise you, and better qualified to do the initial planning and engineering which plays such an important role in the ultimate operating efficiency of specially designed equipment of this type.

See Sweet's Plant Engineering File for Information and Representative Installations, or Write for Catalogue A-660

THE R. C. MAHON COMPANY • Detroit 34, Michigan

Sales-Engineering Offices in Detroit, New York, Chicago, Los Angeles and San Francisco

. . . the **EXPERIENCE** that goes into the **PLANNING** and **ENGINEERING** of **MAHON EQUIPMENT** is the item of **GREATEST VALUE** to **YOU!**

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FULLY AUTOMATIC PLATER & ANODIZER

ONE MAN

handles complete operation of this

MOST VERSATILE

OF ALL AUTOMATICS

Conveyor Breakdowns Eliminated with new electro-mechanical control and safety device. Racks can't be pushed into sides of tank; load can't drop if power fails during work transfers.

Positive 6-Point Connections. Self-cleaning heavy duty contacts need little or no attention.

Rack Carriers Quickly Removed. A big time saver when servicing, or manually plating large pieces.

Fast Cycle Changes by simply moving pick-up heads on transfer truss. No rebuilding or overhauls unless alteration of tank partitions is necessary.

No Extra Headroom Required. All elevating mechanism operates below top of rack carrier.

Automatic Loading And Unloading from double spine racks available.

Delayed Set-Down to operate automatically with cycle. Furnished if required for conversion coatings and bright dips.

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A complete line of quality products and processes developed primarily as a result of helping manufacturers like yourself solve their metal finishing problems. If one of our present products does not meet your needs, we'll be glad to work with you to find an answer to your problem.

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IRILAC™ Clear Protective Coatings for All Metals.

ISOBRITE® *Chemically Different* Plating Brighteners.

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for Metal Finishing

Process Engineered—Single pieces of equipment or all equipment necessary for a finishing operation—evaluated, designed, fabricated, installed and tested to match exactly your particular process. Ask about our *Process Engineering Service.*

WAGNER RECTIFIERS

Silicon and Selenium, built to exacting specifications for long life, trouble-free service.

WAGNER AUTO-LOADERS

for fast, economical transfer of racks and parts, conveyors to plating machines, between conveyors.

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BARRELS, TANKS and other equipment.

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WRITE TODAY FOR COPIES of these useful files describing technical details of our complete line, OR, phone your Allied Field Engineer. He's listed under "Plating Supplies" in your 'phone book.

In response to popular demand, we have organized a Convention Train to be known as the "Metal Finishing Special" on the Santa Fe Railroad from Chicago to Los Angeles. Through sleeping cars on the Erie Railroad out of Hoboken, N. J. will be available and will be attached to the Convention Train which departs from the Dearborn Station in Chicago on Thursday, July 21st.

All day Saturday, July 23rd will be spent touring the Grand Canyon.

The round trip fares provide for an attractively priced family plan and return can be made from Los Angeles on any railroad. The fares quoted will apply returning by all direct routes. For those returning via Canada, there will be a slight additional charge.

SCHEDULE OF FARES

Chicago to Los Angeles via Grand Canyon (Inc. Tax)

First Class Round Trip Fare	$162.53
Family Plan	
Husband and Wife	261.31
Each Additional Family Member	
Age 12-22 Add	98.78
Age 5-12 Add	48.29
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Roomette	46.09
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Double Bedroom	72.38
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New York to Los Angeles via Grand Canyon (Inc. Tax.)

Train leaves from Hoboken, N. J.

First Class Round Trip Fare	$252.18
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Age 5-12 Add	72.66
One-Way Pullman Fares	
Roomette	60.06
Single Bedroom	81.51
Double Bedroom	94.45
Round Trip Coach Fare	181.12
Family Plan Coach Fares	
Husband and Wife	287.22
Each Additional Family Member	
Age 12-22 Add	106.10
Age 5-12 Add	53.08

In order to make the necessary arrangements, if you are interested in the Special Convention Train, please fill in the coupon below and return to us as soon as possible.

Los Angeles Convention Train
c/o Metal Finishing
381 Broadway
Westwood, N. J.

I plan on attending the A. E. S. Convention in Los Angeles and am interested in taking the Special Train. My party will consist of .....

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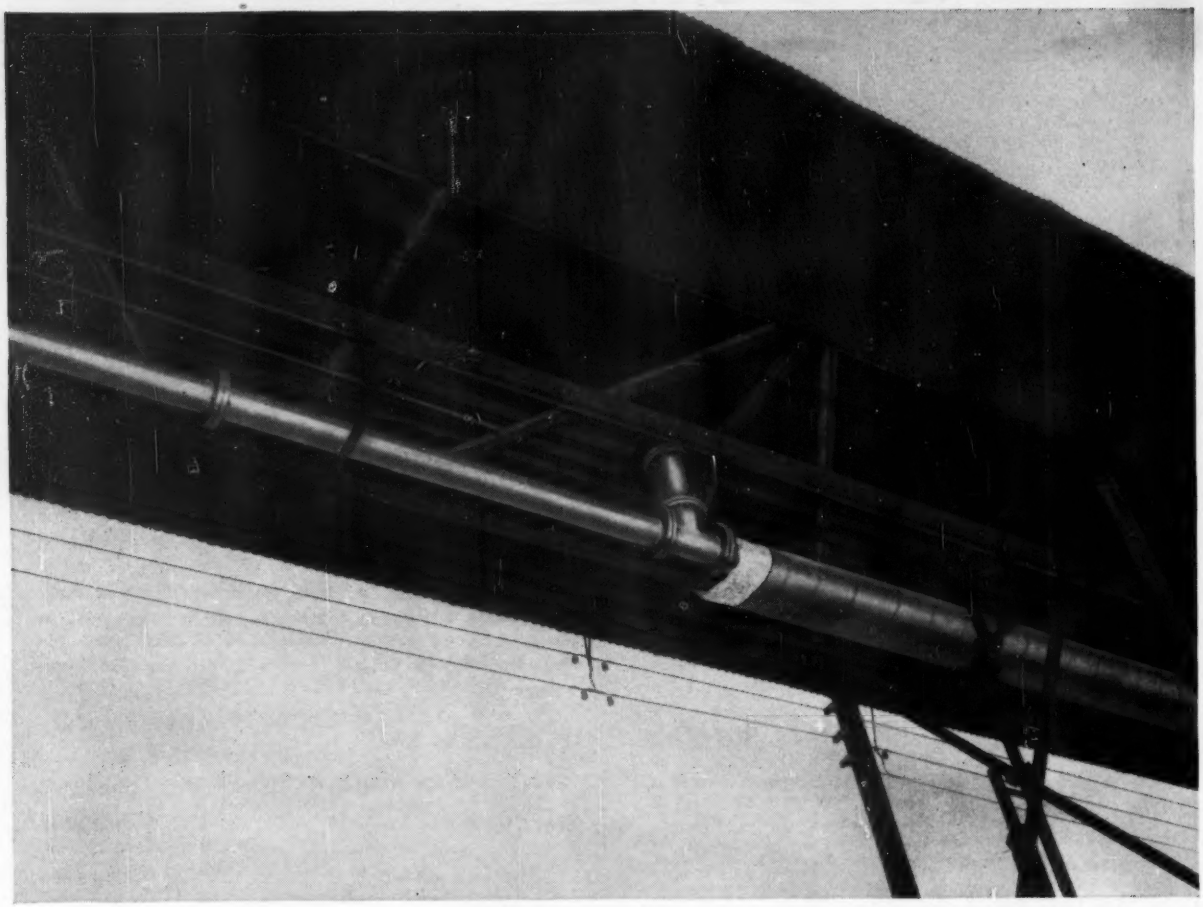
Address .....

City ..... Zone ..... State .....

DOW | **SARAN LINED PIPE**



Eight years and 400,000,000 acid gallons later...

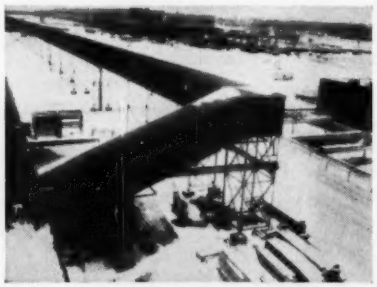
not one replacement due to corrosion in Saran Lined Pipe

A million gallons a week of 100°F. acid rinse loaded with metal precipitates . . . half a mile of pipeline to carry it . . . a perfect combination to tempt corrosion. Thanks to Saran Lined Pipe and valves, there's *never* been a shutdown to replace corroded pipe.

General Electric Company's Erie Plant, Erie, Pennsylvania, has used this line constantly since 1951. Part of the line passes through buildings, taking severe punishment from vibration set up by heavy machinery. Most of the half-mile line is outside, expanding or contracting when temperatures change. Even under these adverse conditions, this Saran Lined Pipe System has shown no signs of mechanical failure.

When your plans include piping systems that must resist corrosion and chemical activity, and that can be easily fabricated or modified in the field . . . call for Saran Lined Pipe.

Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, and from below zero to 200°F. For more information write Saran Lined Pipe Company, 2415 Burdette Ave., Ferndale, Michigan, Dept. 2500CF1.



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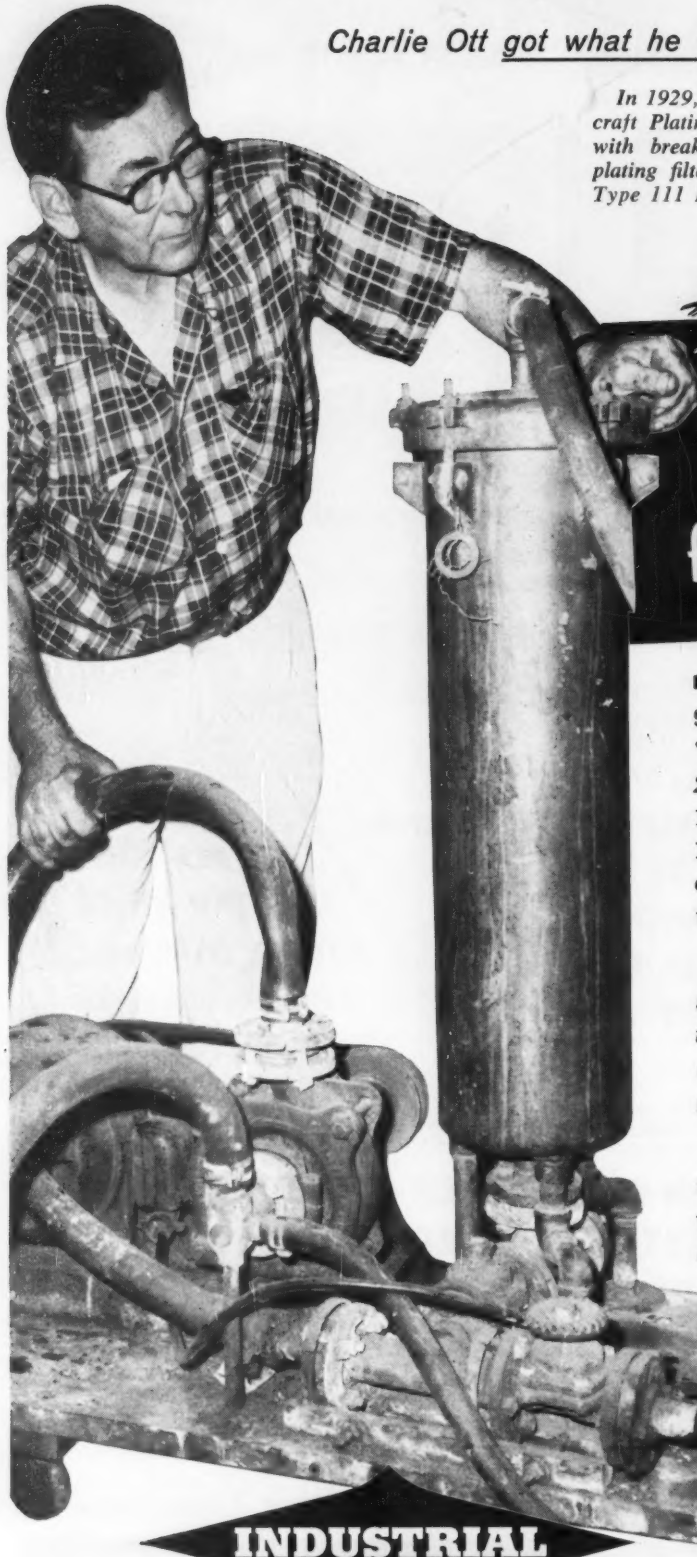
Charlie Ott got what he wanted in a plating filter . . .

In 1929, C. F. Ott, now owner and president of Aircraft Plating and Polishing Company, grew impatient with breakdowns. He wanted a dependable, rugged plating filter. He got what he wanted—*in this early Type 111 Industrial filter.*



"Betsy's been in harness daily for over 30 years"

■ Thirty years ago, "Betsy" was one of only 9 sizes of the Type 111 filter. Today, this "Workhorse of the Industry" is available in *25 standard sizes.* Flow capacities range from 100 to over 30,000 gph. This growth in Type 111 *versatility* is typical of why and how Industrial has earned a position of leadership in the field of plating filters.

Industrial-Engineered systems traditionally give plating people what they want *for the job at hand* . . . highest possible performance potential at the lowest possible cost per gallon of filtrate.

It takes a wide range of models and sizes to meet these requirements—and *you'll* find what *you* want in the Industrial *Plating Bulletin.* Write for a copy.

INDUSTRIAL

INDUSTRIAL FILTER & PUMP MFG. CO.

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P-558

PRESSURE FILTERS ♦ ION & HEAT EXCHANGERS ♦ WASTE-TREATING EQUIPMENT

What do ya mean Copper Oxide causes plating roughness

Our friend on the right means that most roughness in cyanide plating is caused by *copper oxide* rather than metallic copper particles. His theory is this: Copper oxide particles are entrapped under nodules on EDA anodes (electrolytic cathode strips) and in the grain boundaries of most rolled or cast anodes. As these anodes dissolve, the oxide particles are released along with ionized *plating* copper. Most such particles are so small that even bags or diaphragms won't stop them! Solution agitation mechanically transfers them to the products being plated. Once on the cathode surface, they attract ionized copper so strongly that the deposit builds up quickly on them while the immediately surrounding area is starved. And, our friend expounds, that's how you get extreme roughness.

Can you back up his argument? We would like to hear if your own observations will fortify his theory. Or, if you're as sceptical as his opponent on the left, we would also like to hear why you are! Just write the AMCO Technical Service Section.

AMCO DIVISION

American Metal Climax, Inc.
61 Broadway, New York 6, N. Y.

This advertisement is inserted in the Plating Industry's interest—and also in AMCO's. AMCO, as you probably know, is the exclusive producer of OFHC Brand Anodes . . . 99.99+% pure copper, totally free of oxygen and oxides.

Know about Sandoz "bread and butter" dyes?

Trouble-free! Long experience in solving the problems of color anodizers enables Sandoz to assist you in selecting dyes for anodized aluminum which are trouble-free. Here are some of the "bread and butter" Sandoz dyes that require a minimum of control and provide excellent stability in the standing bath, thus resulting in far superior tank life:

Aluminum Gold S	Aluminum Green AX	Aluminum Bordeaux 2R
Aluminum Copper BF	Aluminum Blue A	Aluminum Orange 3A
Aluminum Red RN	Aluminum Violet 3D	Aluminum Yellow 4A
Aluminum Orange 2B	Aluminum Black BK	Aluminum Blue 4A
Aluminum Yellow D	Aluminum Gold EA	

For detailed information and color chips, call or write: SANDOZ, INC., Aluminum Department, 61 Van Dam St., New York 13, N. Y. ALgonquin 5-1700.

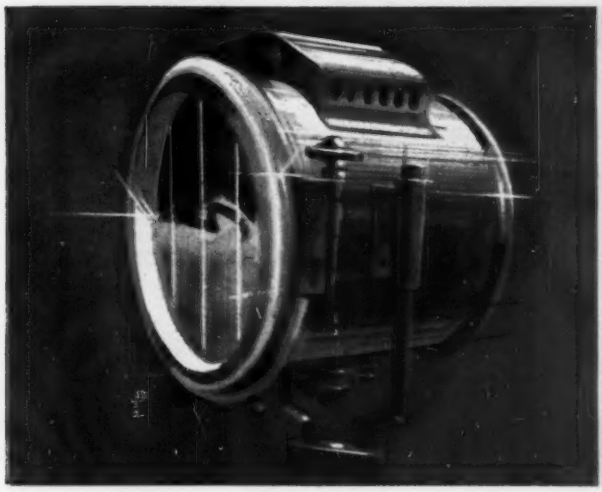
SANDOZ

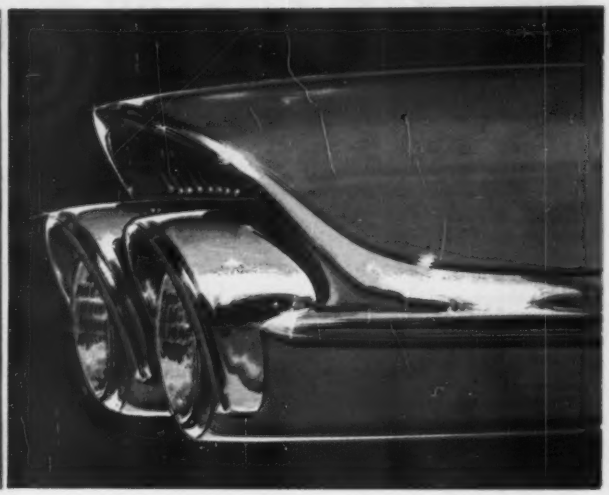
THINKS AHEAD WITH COLOR

SANDOZ

Half a century apart . . .

both finished by Acme machines!



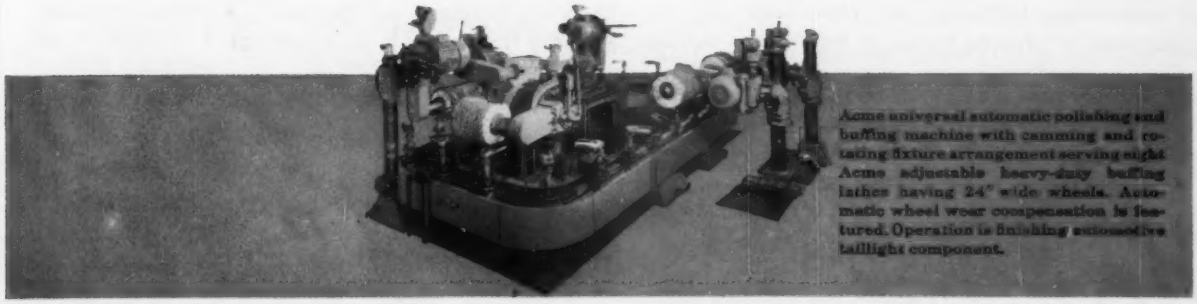


Even in 1910, part of an owner's pride in his car lay in gleaming brightwork. But polishing and buffing the shiny metal that he loved so well caused manufacturers plenty of headaches. And so they turned to Acme—and Acme has continued to supply the answers to their finishing problems.

Today, Acme engineers combine standard units with a variety of accessories to make custom polishing and buffing machines. Large corporations and small job shops alike use Acme machines to reduce rejects, increase production volume, machine finish odd-shaped pieces.

Every year of its history, Acme has encountered new finishing requirements—each an individual problem—and solved them. Chances are, we can solve your problem, too. Send for illustrated 16-page catalog today.

50 years of *Polishing Off* your finishing problems



Acme universal automatic polishing and buffing machine with camming and rotating fixture arrangement serving eight Acme adjustable heavy-duty buffing lathes having 24" wide wheels. Automatic wheel wear compensation is featured. Operation is finishing automotive taillight component.

ACME MANUFACTURING COMPANY

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LEADING PRODUCERS OF AUTOMATIC POLISHING AND BUFFING EQUIPMENT SINCE 1910

Rhodium
ELECTROPLATING SOLUTIONS

Rhodium, hard and very corrosion-resistant, is an excellent electrical contact material.

Its use is suggested on printed circuits, wave guides, and electrical contacts where light contact pressures, low voltage, and intermittent service are involved.

This Rhodium plating solution is easy to use. It operates over a wide range of temperature and current densities. We will be glad to plate samples without charge.

Consult our staff about plating problems.

SINCE 1901

SIGMUND COHN MFG. CO., INC.
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STRIPEX #153
THE NEW MIRACLE

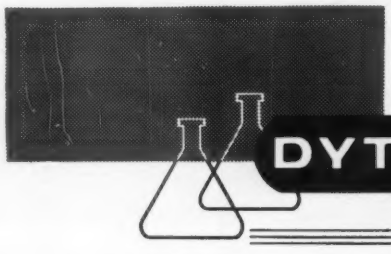
PAINT STRIPPER
NO HEAT NECESSARY!

A mild steel tank is all that is required. Strips all types of baked enamels.

Some baked coatings are stripped clean in a matter of seconds.

Excellent for stripping.

Enamels and Lacquers • Melamines • Zinc Chromate Finishes • Plastisols • Vacuum Plated Finishes • Plating Racks • Insulating Varnishes • Epoxy Finishes • Rubber Coatings • Vinyl Coatings



DYTEX *Chemical Co.*

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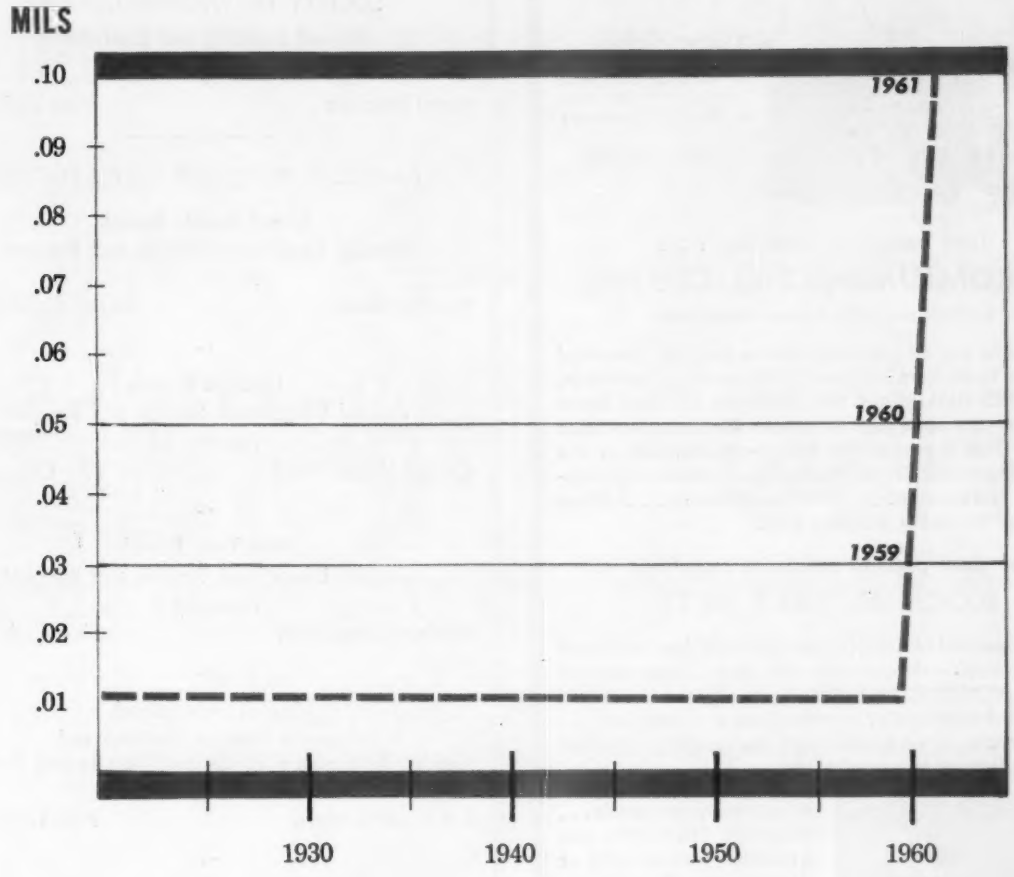
TELEPHONE JACKSON 1-6570
DATA SHEET AVAILABLE UPON REQUEST.

For increased corrosion resistance follow the trend to thicker decorative chromium plating...



with MUTUAL CHROMIC ACID

Yes, the trend is to thicker chromium plating to produce increased resistance to outdoor exposure economically. Today's reports indicate that the thicker chromium plating shown in the simplified graph above makes possible a marked increase in the desired corrosion resistance *without* a proportionately high increase in plating costs. And the sales appeal of your product *goes way up!*

Whichever plating process you may select to produce thicker chromium plating, specify Mutual® Chromic Acid. It's always 99.75% pure—or better. Sulfate content never exceeds 0.1%. Rigid quality control by Mutual insures that the chromic acid you get is always the same. This makes it easier for you to control accurately the acid-sulfate ratio of your plating bath.

OTHER PRODUCTS FOR PLATERS

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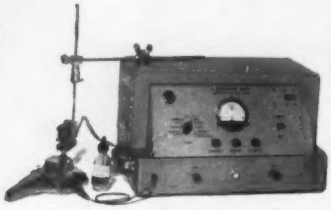
MUTUAL chromium chemicals are available through dealers and SOLVAY branch offices located in major centers from coast to coast. Send export inquiries to Allied Chemical International, 40 Rector St., New York 6.

Thickness Testing . . . Analysis, and pH made simple with

KOCOUR TEST EQUIPMENT



- direct reading
- virtually automatic
- 90-95% accurate
- simple operation

Test composite coatings . . .

CHROMIUM-NICKEL-COPPER

Individual thickness readings

No need to use approximations or lengthy chemical methods to determine composite coating thickness. Model 955 determines the thickness of each layer with separate readings of actual thickness for each coating. This is one of the many applications of the Kocour Electronic Thickness Tester. Operation is simple and automatic . . . 90-95% accurate . . . direct readings. Write for Bulletin 400.

Control your plating solutions regularly with

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Regular control is not only convenient, but you save time . . . avoids delays and shut down, and prevent trouble, KOCOUR TEST SETS provide the best and most direct methods of control. They are complete . . . simple to use . . . no knowledge of chemistry required . . . calculations are minimized.

Whatever your needs . . . KOCOUR TEST SETS are available individually or in economical combinations for the control of plating, cleaning, pickling, anodizing, sealing, coating, passivating, desmutting, deburring, phosphorizing, heat treating, pH control and thickness testing. Write for your FREE copy of "Lab Hints for the Plater."

● KOCOUR testing sets are used all over the world for controlling plating — cleaning — pickling — anodizing — and hardening processes . . . special sets can be provided for your requirements.
Write today for complete information — no cost or obligation.

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SOCIETY OF VACUUM COATERS
Annual Meeting and Conference
January 26-27
Hotel Biltmore — New York, N. Y.

AMERICAN ELECTROPLATERS' SOCIETY

Grand Rapids Branch
Annual Educational Session and Banquet
January 23
Pantlind Hotel — Grand Rapids, Mich.

~

Chicago Branch
Annual Educational Session and Banquet
January 30
Conrad Hilton Hotel — Chicago, Ill.

~

New York Branch
Annual Educational Session and Banquet
February 6
Statler-Hilton Hotel — New York, N. Y.

~

Philadelphia Branch
Seventh Interim Meeting and
Golden Anniversary Educational Session and Banquet
February 19-20
Ben Franklin Hotel — Philadelphia, Pa.

~

Cincinnati Branch
Sixth Tri-State Regional Meeting
April 23
Sheraton-Gibson Hotel — Cincinnati, Ohio

~

Bridgeport Branch
Twenty-First Annual New England Regional Meeting
April 23
Hotel Statler — Hartford, Conn.

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Southern Tier Branch
Sixth Empire State Regional Meeting
April 29-30
Mark Twain Hotel — Elmira, N. Y.

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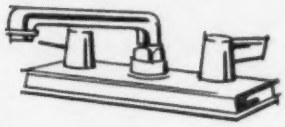
Los Angeles Branch
Forty-Seventh Annual Convention
July 24-28
Hotel Statler — Los Angeles, Calif.

This is LECTRITE 'Z' ...the new electrocleaner that removes all dulling films from all zinc die-cast alloys. Use it for side-view mirrors or refrigerator handles . . . plumbing fixtures  or furniture hardware. You'll get streak-free, shadow-free plating every time!

And...LECTRITE® 'Z' is adaptable to hand lines and automatics—will even handle die castings and brass parts in the same line. It is built with heavy-duty, anhydrous ingredients for long and trouble-free service. It provides a light foam blanket that is right for all electrocleaning operations—eliminates explosion possibilities, yet retains fumes. It is non-dusty and easy to handle.

If you can use advantages like these, put LECTRITE 'Z' to work. Get in touch with your Wyandotte representative, today. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California, and Atlanta, Georgia. Offices in principal cities.*

Wyandotte CHEMICALS

J. B. FORD DIVISION • *The best in chemical products for metal finishing*

The Answer to your toughest tank lining problems

TYGON

flexible – plastic

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TOPS IN CORROSION-RESISTANCE

PROVEN in hundreds of the toughest possible applications during the past eighteen years, flexible Tygon plastic tank linings offer more value today than ever.

Greater toughness; even better chemical resistance, particularly to chromic and other highly oxidizing acids; longer life.

This better Tygon lining (Formulation 105-A) represents a major step forward in the development of heavy duty plastic sheetings for corrosive service. Tygon linings are now extruded, not calendered. They are completely free of "laminations" — cannot "peel" in service. Under continuous immersion these better Tygon linings show negligible extractibility.

Available in 3/32" and 3/16" thicknesses, Tygon can be installed by strategically located licensed applicators quickly and inexpensively.

For that next "tough" tank lining problem — ask for, insist on — TYGON.

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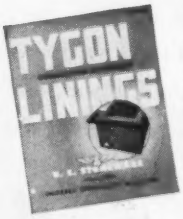

This booklet tells the "down-to-earth" facts about Tygon. Where and how to use it. When not to use it. A valuable reference for every engineer faced with corrosion problems. Free on request. Write for your copy today! Ask for Bulletin TL-526-R. Address: Plastics & Synthetics Division, The U. S. Stoneware Co., Akron 9, Ohio.

U. S. STONEWARE

AKRON, OHIO

Tygon is the registered trade-mark of The U. S. Stoneware Co.

LEA

ABRASIVE FINISHING METHODS

SILVER SOLID AND ALLOYS

STAMPINGS • SPINNINGS • CASTINGS

Of the noble metals silver is by far the most widely encountered in the metal finishing field. It is seldom used in the pure state but mainly in an alloy, such as sterling silver and, to a lesser degree, coin silver. As is commonly realized, the alloying elements, principally copper, are used to increase hardness and wear-resistance.

Because of the relatively high value of the metal, greater care is justified in devising the proper Lea Methods to see that metal losses in the finishing operations are kept to a minimum. The much higher price obtained for sterling silver articles justifies the greater finishing care.

Plated Silver, certainly an important subject, is discussed separately.

Following are the more widely used finishes for sterling and coin silver together with suggestions for producing them:

HAMMERED FINISH... Formerly, much silver was hammer-finished in order to refine the surface and because the alloys could be shaped readily by this method. The method is still used extensively, especially on reproductions. With hammering, of course, no silver is removed by abrasion.

DULL MATTE FINISH... With this finish, as well as with all the following finishes, the metal is first conditioned by "washing out" the pits by either spot sand bobbing or flexible polishing with **Grade "C" or Grade "B-31" Lea Compound** on leather or felt bobs. This step is usually followed by cut-down buffing with a Tripoli composition such as **Grade 765 Learok** and then by brushing at low speed with a suitable mixture of pumice and water.

DULL SATIN FINISH... Proceed as with the dull matte finishing up to but not through the pumice and water step. At that point, follow with a buffing step using **Grade "C" or Grade "B-31" Lea Compound,** whichever is better, at a speed of about 5000 sfm.

BUTLER FINISH, SEMI-BRIGHT TO BRIGHT... Follow the steps given under dull matte finish up to and including the **Grade 765 Learok** cut-down. Then proceed with the final finishing operations, using **Fine Silver grades of Lea Compound,** such as **Grades MH, B12 or 5023,** to give the desired butler finish. Full-disc or packed muslin buffs are used at 7000 to 7500 sfm.

SEMI-MIRROR FINISH... Proceed as with the dull matte finish, through the **Grade 765 Learok** cut-down step. Then follow with coloring, using either **Grade 302-C or Grade 884 Learok** on a loose muslin buff at 7500 sfm.

Where automatic buffing is being done **Grade TH52P Lea Liquabrade** is used for a cut-down operation and **Grade UH20A Liquabrade** for coloring.

MIRROR FINISH... Proceed as with the semi-mirror finish except use **Lea Red Rouge A100 Bar Compound** or **Grade 63LR Liquid Rouge.**

ULTRA-MIRROR FINISH... Proceed as with the mirror finish and follow with lamp black and kerosene.

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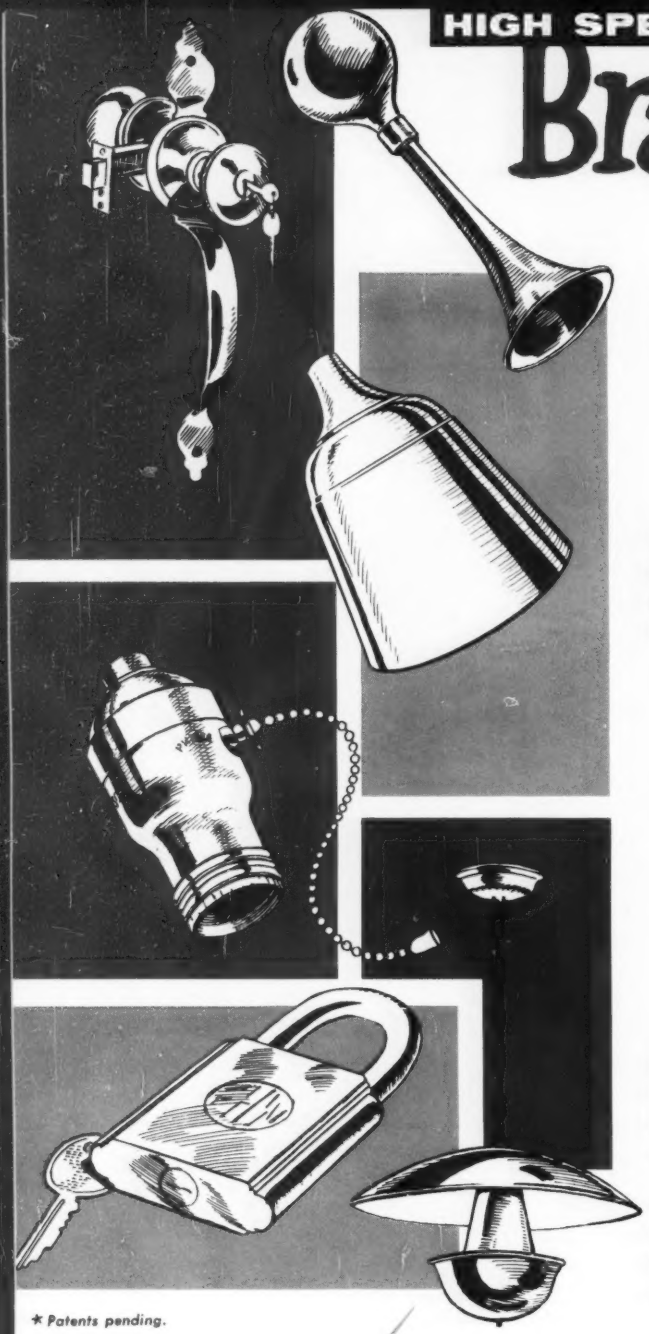

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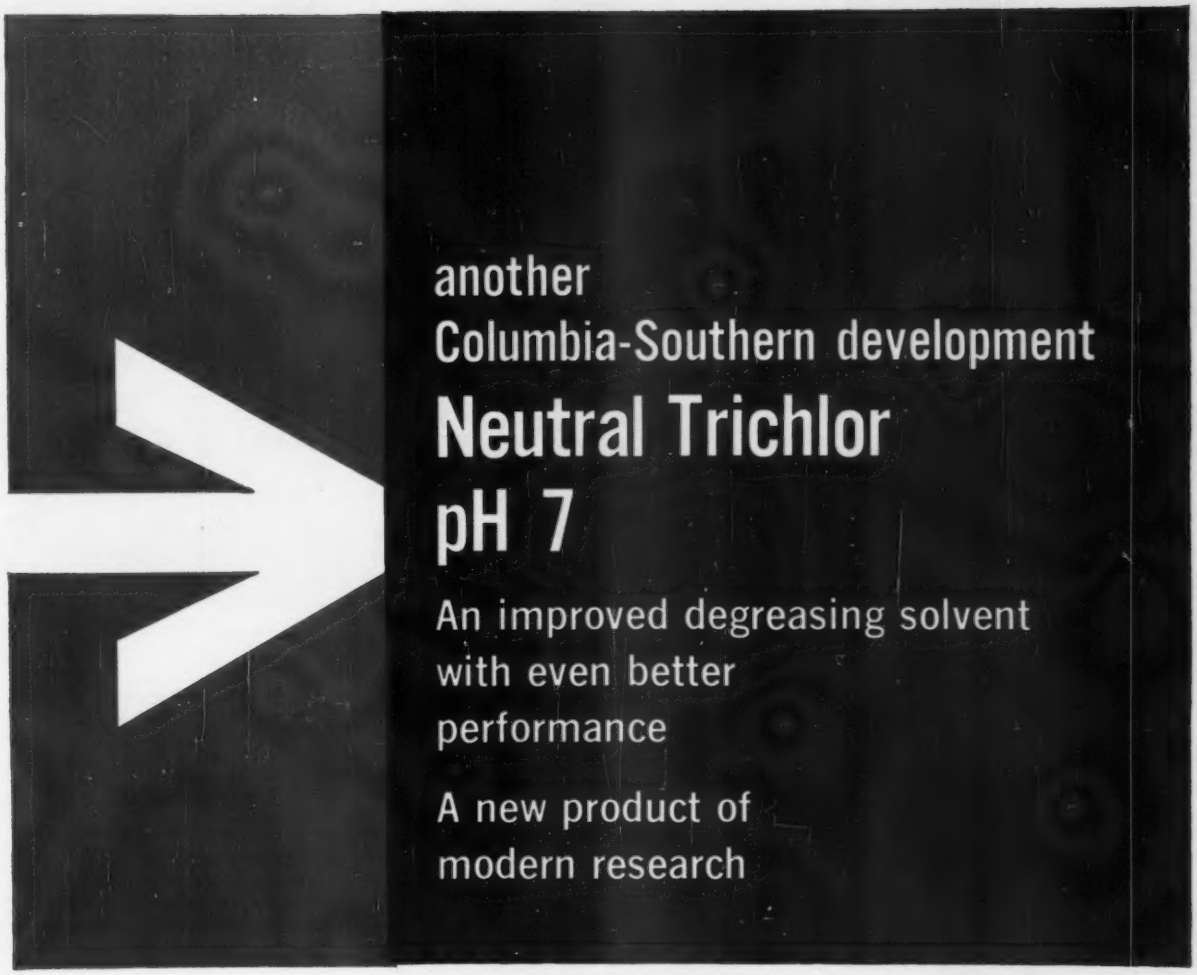

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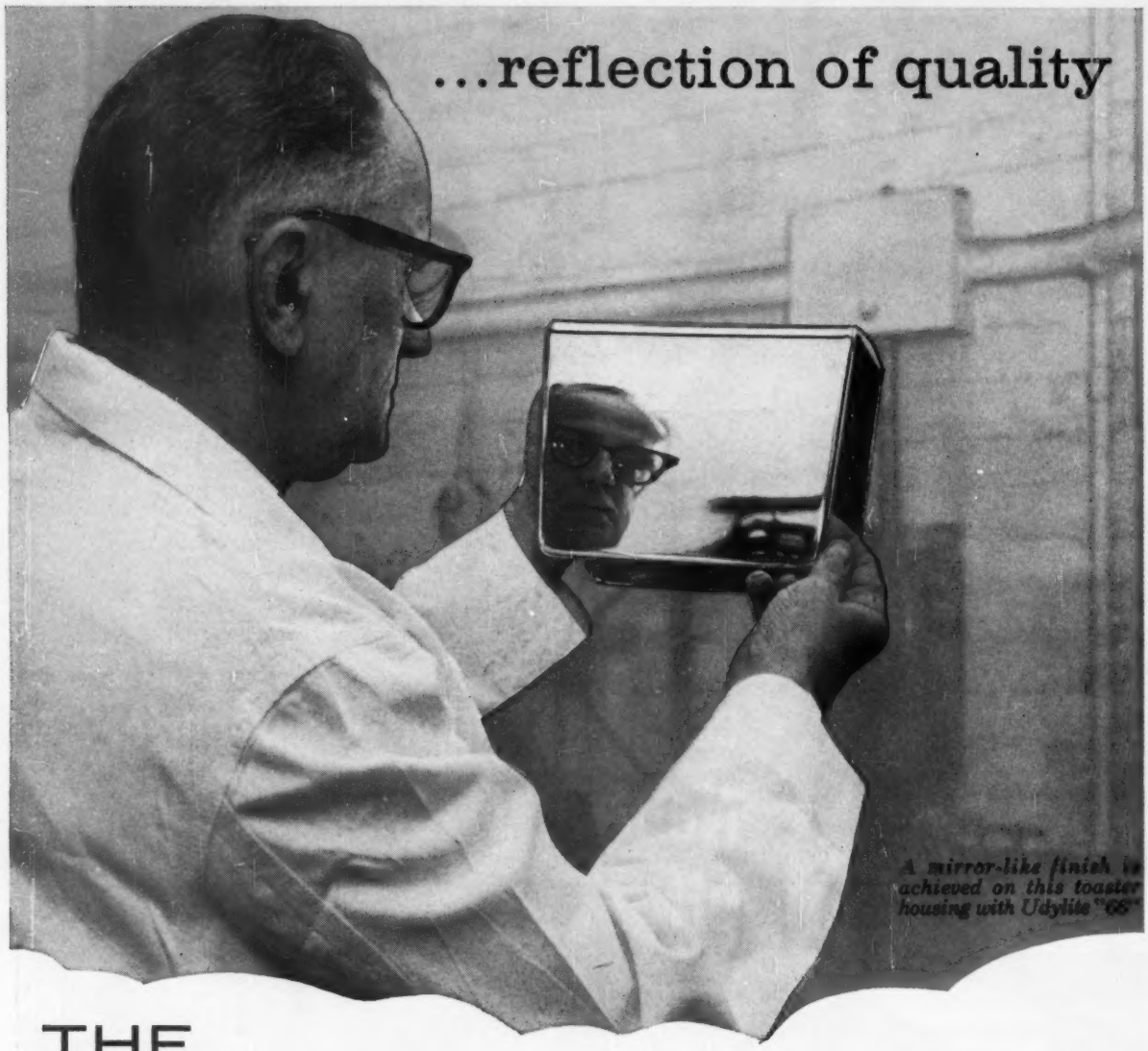

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Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

JANUARY, 1960 Volume 58 No. 1

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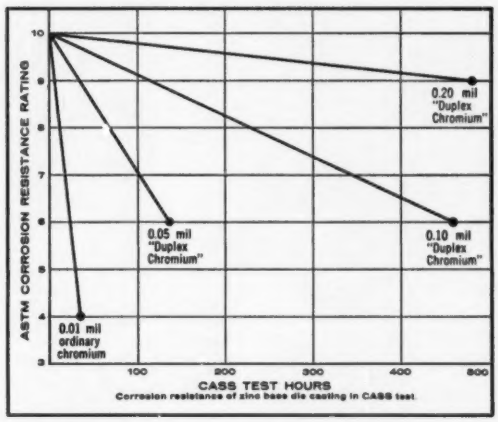
How to get the optimum protection of bright chromium plating

There are three requisites to increasing corrosion protection from chromium plating. (1) The deposit must be sufficiently thick. (2) There should be a crack-free chromium base topped by a special, finely cracked chromium deposit. (3) The plate should be more uniformly distributed over the part, so that recessed areas, too, are assured at least 0.03 mils minimum chromium thickness.

All of these requirements are easily met through UNICHROME SRHS® CHROMIUM plating processes. Work done for the automotive industry, long plagued by corrosion of brightwork in outdoors exposure, provides a good case in point.

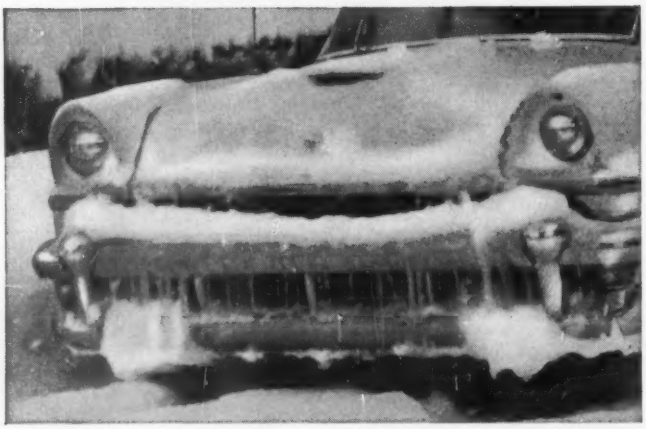
AN ANSWER TO OUTDOOR CORROSION

Note the results in the chart at right. In all cases, the thickness of undercoats was kept constant. Only the chromium plate was varied... from ordinary to "Duplex", and progressively thicker. M&T "Duplex Chromium" calls for first using Unichrome Crack-Free Chromium and its ability to throw into recesses and give a more uniform and fracture-free plate. This is followed by another deposit of Unichrome SRHS Chromium, with its *controlled* cracking. With increasing thickness, the protection increased tremendously. Durability as determined by rigorous, accelerated corrosion testing techniques was multiplied as much as *20 times.*



Zinc die cast specimens, all plated with 0.75 mil copper and 0.75 mil nickel prior to chromium lasted as shown above in the severe CASS test (Copper accelerated acetic acid salt spray). Ordinary chromium fared poorly. Optimum protection was approached by using Crack-Free Chromium and increasing the deposit thickness.

Despite severe service conditions, automotive brightwork can stay bright now, due to the additional corrosion protection that M&T "Duplex Chromium" provides.



WIDELY USEFUL FINISH

While the above case concerns itself specifically with an automotive problem, it indicates what thicker chromium in general, and crack-free chromium in particular can do for other design problems involving corrosion and wear. This plate blocks infiltration of corrosives to underlying metal.

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ESTABLISHED 1903 VOLUME 58 • NUMBER 1 • JANUARY, 1960

THE OUTLOOK FOR 1960

Once again the month has rolled around when trade paper editors are expected to look into their crystal balls and prognosticate what is in store for industry in general, and for their own avid readers in particular.

For the first time in two decades, management decided last year that, in labor contract negotiation, it would stand firm on the principle that it is just as blessed to receive as to give. The effects of the resulting strikes, especially in steel, will be felt for many months. Although evidence during the last quarter of 1959 indicated a firming of the nickel market, steadily increasing production of this metal has eliminated any possibility of a shortage. With steel and auto industry consumption down, accumulated stocks will insure enough nickel for all, even allowing for the boost in purchasing after the strike settlement.

The steel strike may accelerate the trend toward aluminum, and more finishers will expect to work with the light metal, improving the prospects of equipment suppliers accordingly. Auto trim uses have more than tripled in the last four years, and aluminum bumpers are said to be a possibility for some car models in 1961; the remaining obstacles appear to be inferior luster and durability of the anodic coatings, and the practice in automatic car wash stations of using harsh steam cleaners.

Although anodized aluminum has encroached on copper-nickel-chromium plating, the expectation is that there will be little if any deactivation of plating facilities. Higher standards, such as the new requirement for 50 per cent more nickel on zinc-base die castings and steel for exterior exposure, will take up the slack. Duplex nickel, duplex chromium, and relatively thick, crack-free, decorative chromium coatings, all have been shown to enhance the corrosion resistance to a marked degree. Their adoption, which is almost a certainty, will necessitate longer plating cycles which, in turn, will require more equipment than formerly found adequate.

If the steel strike has benefited anyone it has been the warehouses which, as a result of the scarcity, were able to unload whatever was lying around in the way of old stocks. Finishers will be suffering for some months with steel of inferior quality from this source, even if we assume, optimistically, that the mills will be shipping steel of the highest quality from the start. We anticipate the appearance on the market of articles which will reflect no credit to our industry, though the fault will lie with the metal rather than with the metal finisher. But, all this shall pass! And, eventually, things will be back to normal again. All we will need will be a thick skin and patience, plenty of patience!

Nathaniel Hall

Technical Developments of 1959

By Nathaniel Hall, *Technical Editor*

Cleaning

EXCLUDING special procedures for ensuring adhesion of electrodeposits to metals, the past year was not outstanding as concerns cleaning, with only three articles appearing and a handful of patents issued. Lindford & Grunwald[1] studied the *effect of a fatty acid film on adhesion,* finding that very thin films have no effect; Spring[2] described the safe deviations possible from *ideal cleaning conditions,* and Sugden[3] surveyed the practice of *cleaning with ultrasonics.* Spring also received a patent on an *emulsion cleaner,*[4] and non-tarnish *cleaners for copper* and for *silver* were claimed by Wasserman[5] and by Ruff & Smith.[6]

Advances in *cleaning equipment* were covered in patents granted to Wolfgang for a tank equipped with a vibrator,[7] to Henzel for a spray washer,[8] and to Schuchman & Norris[9] for a *vapor-spray* cleaning machine. Other patents comprised one to Smith[10] for an electrode for *continuous electrocleaning* of strip metal, and another to Kearney & McNamara[11] for a *drum-type cleaning machine* with an interior spiral.

No articles on solvent degreasing worthy of comment appeared in the literature but four patents were granted. *Solvent degreasers* were claimed by Zademach, Auger & Lans;[12] and by Randall & Randall,[13] the latter for an automatic machine. Lebsanft & Schmidt disclosed the addition of *finely divided particles* of polyvinyl chloride to the chlorinated hydrocarbon solvent,[14] and Weis[15] an *improved hydrocarbon solvent* containing a detergent-dispersant for petroleum residual products.

In the field of *abrasive blasting,* two articles were noted; one by Sorace[16] pointed out that *descaling wire continuously* by use of the method avoids pickling wastes, and costs are comparable with other methods, and Zavarella[17] described *wet blasting* as it is applied to hard chromium plating. Contributions from the inventors were more numerous. Brunner patented a method of blasting with *walnut shells,*[18] and machines were covered by four more, to Bolton & Ruse[19] for vapor or sand blasting, to Gossard[20] for a reversible *centrifugal method,* to Schultz[21] for an oscillating machine, and to Fritze & Smith[22] for blasting pipe interiors. Improvements in *nozzles* were claimed by Rutledge;[23] by Stokes, who devised a dual abrasive nozzle;[24] and by Hastrup & Hastrup.[25]

Pickling

Pickling received an unusual amount of attention, even excluding the preparation of metals for subsequent deposit adhesion, which now appears to be of sufficiently broad interest to warrant a separate section in this review for the first time. Pickling and acid dipping *solutions for various metals* were the subject of a comprehensive article by Mohler,[26] Wilson discussed procedures for *porcelain enameling,*[27] and Sachs & Melbourne reported the results of their tests on *hydrogen embrittlement of steel.*[28] Refractory metals were treated in one article, by Fishlock[29] on currently available pickling processes for *titanium and its alloys,* and in two patents, to Fischer for a fused alkali metal hydrogen fluoride salt bath for *zirconium,*[30] and to Bomberger & Vordahl[31] who claimed avoidance of hydrogen embrittlement of both *titanium and zirconium* by using a pickling solution consisting of phosphoric acid, fluoride and an oxidizing agent. A solution was also disclosed by McFarland[31A] consisting of HF and HNO_3.

The patent pages disclosed a number of developments for specific metals and alloys. *Aluminum* was covered by Newhard, Jr. & Thirsk,[32] by Deer,[33] and by Brown.[34] *Iron* was the subject of two which combined scale removal with inhibition of subsequent reoxidation, one granted to Henricks,[35] and the other to Certa.[36]

Nickel-Iron-cobalt alloys could be pickled, without attack on the basis metal, in a heated solution of ammonium sulfate and sulfuric acid according to Certa also,[37] while Zaremski & Beigay claimed a solution of acetic and hydrofluoric acids containing a very small amount of titanium for pickling *nickel and its alloys.*[38] For *scaled chromium-steel,* Hong suggested heating in a reducing atmosphere followed by immersion in hot sulfuric or muriatic acid.[39] An *alkaline deruster* containing gluconate, saccharate, and E.D.T.A. compounds to complex iron was disclosed by Meyer.[39A]

An interesting application of *ultrasonics* was disclosed by Engelhardt,[40] who treated metals in an acid bath to loosen the scale, which was then removed in a subsequent water bath with the help of ultrasonics. In the single article on *pickling inhibitors,* Edwards, Nowacki & Mueller[41] reported that acetylinic alcohols provide a substrate which increases the corrosion resistance of subsequent epoxy-phenolic coatings. Two new inhibitors were patented, by Mansfield, Morrison & Schmidle,[42] and by Pumpelly & Wasco.[43]

Polishing

MECHANICAL:

There appears to be a steadily increasing interest in mechanical polishing of metals although, fundamentally, there has been no change in basic principles

during the past hundred years. To those who are familiar with the controversy over the presence or absence of the Beilby layer, the *electron diffraction studies* of Samuels & Sanders[44, 44A] would be noteworthy. Their investigation of polished silver surfaces showed no evidence of this layer, which should settle the matter once and for all. Langford[45] also confirmed the absence of the *Beilby layer*, concluding that the polishing action is by cutting, not by surface flow. Along more practical lines, Spencer reviewed the fundamental considerations in polishing and buffing, covering metals, wheels, abrasives, and procedures;[46] Silman & Hughes[47] surveyed the equipment and applications of *automatic polishing* using *liquid buffing compositions;* and, Sax explained the construction of different *buff types* and their uses.[48]

The usual collection of improved *buffs* appeared in the patent disclosures and, for readers who would seek further, the patents are listed in the references following this review.[49-57] Two patents to Vaughan, Hislop & Hanna[58] claimed improved wear resistance by *resin treatment* and soya bean oil impregnation. *Flexible* abrasive wheels and brushes were claimed by Cosmos,[59] Hall & Paone,[60] Peterson,[61] Hall,[62] and by Reed, Rankin & Tungseth.[63]

Three articles worthy of note appeared on *stainless steel.* Spencer surveyed the field of polishing and buffing these alloys,[64] Sax,[65] described materials and practices employed in buffing, and Zimmerman[66] detailed, in one article, the procedure for buffing stainless steel strip in continuous lengths for *color matching* while, in another, he discussed the role of metallurgy in *flat polishing.*[67] Belt polishing was a subject which occupied a number of other authors. Spencer discussed the basic factors involved in the selection of *abrasive sheets and belts,*[68] Seward[69] described their uses, and Reed covered the factors which influence *belt performance.*[70] Aspects of the subject which are not appreciated sufficiently were pointed out by Tuvek,[71] who suggested *prefinishing with belts* to reduce subsequent barrel tumbling time, and by Eshelman,[72] who listed the *advantages* of the process prior to forming. Patents were granted on belt polishing equipment and methods to Meyer,[73] Hjelstrom & Catlett,[74] Keating,[75] and Zirbel.[76]

Other patents included a *lime-based buffing compound* containing an anti-oxidant, claimed by Gibson & Bogdanoff;[77] *anti-slaking* compositions, disclosed by High,[78] and by Riegler & Dybalski;[79] and a *packaged buffing compound* detailed by Couch & Candee.[80] Simjian was granted patents on a process involving *electromagnetic agitation* of the polishing media in which the part is immersed,[81] and on another for polishing with *sonic energy,*[82] methods which fill the void between wheel and barrel finishing. Machines were also patented by Pettit & Geisler for *brushing hollow objects,*[83] and by Peterson for *sheet and rod.*[84] A liquid buffing compound *spray gun mover* was claimed by Burt.[84A]

CHEMICAL AND ELECTROLYTIC:

Although interest in these subjects is more widespread than ever, developments have been fewer, especially in chemical polishing, or bright dipping, which accounted for only two articles, in which Brown described an *automatic machine* for bulk treatment of light bulb basis,[85] and Spahn[85A] gave operating details and discussed the chemistry of the process for *copper and its alloys,* and two patents: to Hampel on a solution of chromic, nitric, and hydrofluoric acids for zinc,[86] and to Ostrander & Congiundi on chromic, sulfuric, nitric, and boric acids for zinc and cadmium.[87]

Electropolishing was the subject of only three articles; Mohrnheim[88] reviewed the literature on aluminum processing from 1946-1958, Abadie & Vidal[88A] found that the *fatigue strength* of this metal is not affected by the process; and Mondon[88B] described the status of industrial practice in Europe. Patents, although more numerous, dealt with the less commonly polished metals. Baier & Wodetzky claimed a solultion of phosphoric, chromic, sulfuric, and hydrofluoric acids;[89] Zaremski employed a molten caustic soda bath for *titanium and zirconium,* with a noble metal as an internal electrolytic couple;[90] and Bowerman & Saubestre[91] employed hydrochloric and acetic acids for *nickel.* Walker & Noland[92] electropolished *uranium* in a bath consisting of sulfuric acid, glycerine, and water, and McCord & Spink[93] claimed an ammonium fluoride bath for *zirconium and hafnium.*

BARREL FINISHING:

Simjian was responsible for two of the three patents in this field, one on a *tumbling barrel,*[94] and the other on a method which involved rotation of parts in a *magnetizable material.*[95] A tumbling barrel was also patented by Smith-Gorman.[96]

The half-dozen articles on the subject were of a descriptive nature and disclosed nothing of a radical nature, although of especial interest were the data presented to show that the treatment boost *fatigue strength* by inducing a compressive stress in the metal surface.[97-8] Machines were described by Fishlock,[99] and by Maynes[100] who also included media and compounds for use prior to plating. Tumbling *castings* was the subject of an article by Stevens,[101] and another article, by Tuvek, described finishing of *tungsten carbide* parts,[102] while Mosher, Soper & Loll[102A] detailed materials and techniques.

Anodizing

Aside from one item on *magnesium,* a patent granted to DeLong[103] for a solution consisting of acid chromate, phosphate, and fluoride, the literature on anodizing concerned itself only with aluminum. Finney described the effect of pickling and anodizing on the *fatigue strength of alloys,*[103A] and Herenguel & LeLong[104] found that hyper-hotworking of the metal resulted in improvement in anodizing properties and *resistance to corrosion.* Flusin[105] described the factors affecting the *oxide film formation,* and Kape discussed the deterioration of anodized aluminum exposed to *corrosive environments.*[106] Developments and *European practice* were reviewed by Lattey[106A] and by Brace[106B] respectively.

The production process was the subject of some interesting articles. Flusin reviewed the subject,[107] while Brace[108] covered the applicability of the various methods to *automatic operation.* Best, Hecker, McGrew

& Vanden Berg[108A] described the *characteristics of various alloys* in the chromic acid bath. Recommendations for production of *quality coatings* were made by Kerr,[109] and Dale, Esmore & Howell[110] described the cycle for obtaining *mirrors* with high purity aluminum.

Hard anodizing was responsible for two articles, by LeLong, Segond & Herenguel[110A] on very thick film production, and by Owens who discussed valid methods for checking quality,[111] and two patents to Franklin on *production refinements.*[112-3] *Sealing* of the oxide film was covered by three article, in which Kape detailed sealing methods and *tests* for sealing efficiency,[114] Wernick[114A] reviewed the process, and Hunter, Towner & Robinson[114B] found *hydration of the oxide films* to be influenced by pH, temperature, and certain ions; and by two patents, one to Stiller who claimed *smut elimination* as a result of adding a lignosulfonate to the metal salt sealer,[115] and the other to Spooner for a *molybdate* sealing solution.[116] Other patents were to Mostovych & Cybriwsky[117] for a continuous *strip anodizing machine,* and to Brown[118] for perfluoroalkane sulfonic acid as a *spray depressant.*

Treatments for Deposit Adhesion

With increasing utilization of light metals, transition metals, and "exotic" alloys, a significant amount of work has been done of late in connection with the problems involved in producing adherent deposits on them. The stringent requirements of users, mainly the armed forces and the electronics industry, have necessitated some unique procedures, and these are being reported with such frequency as to suggest the advisability of a separate section in these yearly surveys.

Of the light metals, *aluminum* was the subject of only one article, in which Metrailer detailed procedures for plating on aluminum die-castings in production.[119] However, four patents were issued, two to Atkinson[120] for depositing *copper* directly, using pyrophosphate-oxalate baths and citrate-fluoride-sulfate baths, respectively. Miller[121] applied immersion deposits of copper from a *complex amine bath,* followed by zinc, cadmium, or tin from the same type of bath, then heat treated to form an alloy layer. Howard[122] used a *zinc-lead alloy strike* from a cyanide solution containing a chelating agent prior to copper striking, and Wasserman[123] deposited *chromium* directly on the aluminum employing anodic, followed by cathodic pretreatment in weak hydrochloric acid. Tandon & Banerjee[124] briefly described processes for *aluminum and for magnesium, beryllium and titanium;* Levy discussed the factors in successful *plating on magnesium;*[125] and Townsend patented a method of plating on *beryllium,* which involved etching in acid, double zincate and copper plating.[126]

The Group IV, V and VI *transition metals* were surveyed in a complete paper by Saubestre.[127] Specific metals of this group were treated by Murphy[128] who reviewed methods for *titanium,* and by Kohan[129] who presented formulas and procedures for producing immersion deposits on *zirconium alloys.* From the inventors came two patents, one to Slatin for nickel plating *tungsten carbide* with a prior anodic etch in sodium pyrophosphate,[130] and the other to Schaer & Beach[131] for *protection of molybdenum* by first chromium striking, then gold plating, and finally chromium plating again.

The atomic energy specialists were not idle during the past year. Beach & Faust deposited aluminum on *uranium,* using organic baths[132] and procedures for plating on uranium were also treated in three patents; to Slunder who anodized the metal in phosphoric acid containing a small amount of HCl;[133] to Gray for a similar procedure,[134] followed by a nitric acid dip; and to Rebol & Wehrmann,[135] who pickled in trichloracetic acid and then nitric dipped. *Thorium* was pretreated by anodic pickling in HCl, followed by immersion in H_2SO_4, in disclosures by Beach & Schaer.[136]

Nickel alloys appear to present no problems, the literature turning up two new articles, in one of which Calderon showed how to deposit silver directly on *Inconel,*[137] and in the other Domnikov[138] described a hot sulfuric acid dip for *stainless steel,* followed by immersion nickel deposition prior to plating. In the single patent, Scavullo claimed a lengthy process for *silver plating stainless steel,* consisting of nickel striking, copper striking, silver striking, wire brushing, and silver plating in that order.[139]

A few miscellaneous items dealing with preparation for plating are also worthy of listing. West[140] described electroless nickel plating on *carbon,* and Turner[141] the production of metal contacts on *germanium and silicon* semi-conductors. A patent was granted to Boyett for the use of *wet blasting* to clean and produce an air-impervious layer of fine abrasive on the surface,[142] which was removed by the gas evolved in the plating bath. Another patent, to Smith & Latva,[143] disclosed pretreatment of porous, sintered metal *powder compacts* by soaking in microcrystalline wax to fill the pores, followed by tumbling with abrasive and detergent.

Metallic Coatings

NICKEL:

Nickel plating received the major share of treatment in the literature, as befits its position in the industry. Reports were presented on various baths: Steiger described a Russian *hard nickel* solution consisting of nickel sulfate and ammonium oxalate, at pH 7.5-8 and elevated temperature;[144] Panikkar & Rama Char[145] pointed out that the *pyrophosphate bath* gave good quality deposits over a wide operating range and had some advantages over the Watts bath; Fanner & Hammond[146] also compared the Watts bath, but with the *sulfamate* formulation; and Chaybany investigated the influence of impurities in a sulfate bath containing *potassium bromide,*[147] which gave bright deposits. The effect of flow rate and current density in *electrolytic purification* of a Watts bath was studied by Max & Whithurst.[147A] The advantages of the *high-chloride* bath were detailed by Tippman[148] for decorative plating, and a patent was obtained by Kardos & Neumann for the production of *duplex coatings* in a single bath by plating first without, then with agitation.[149]

In an interesting investigation, Banerjee & Goswami[150] used *electron diffraction* to study the effects of solution conditions on *crystal structure, orientation, and mode of growth* of the deposits. Geneidy, Koehler & Machu found that magnesium salts increased *cathode*

efficiency, improved throwing power and reduced the porosity.[151] At high concentrations it resulted in harder deposits, with increased brittleness and tensile strength. Edwards, in a study of proprietary bright nickel baths, found that the amount of *organic material codeposited* increased with increasing length of bath service,[152] while Jones, Lu & Mohrnheim[152A] investigated ferrous metal conditions affecting *durability* of Watts nickel deposits.

Leveling nickel was almost ignored, the only work of real importance being reported by Beacom & Riley,[153] who studied the effect, using radioactive sodium allyl sulfonate as a brightener. They found that the organic material is preferentially adsorbed or codeposited on high points. Beacom also reported that apparent greater cathode film thickness in valleys, when leveling agents are added to a *Watts nickel bath*, parallels the conditions for maximum leveling.[154] *Addition agent* patents were listed by Dubpernell[155] in a *history* of nickel plating, and patents were obtained by a number of inventors.[156-62]

Electroless nickel was treated in a few articles, in one of which Gutzeit extensively dealt with the chemistry of the catalytic process[163] and, in the others, Edge discussed the *practical aspects* of the process,[164] and Spraul presented corrosion resistance data for numerous chemicals.[164A] Patents included five on *replenishing and regenerating* the bath, issued to Hays,[165] Metheny,[166] Lee,[167] Budininkas,[168] and to Duvall.[169] *Stabilization* by addition of minute amounts of metal salts was claimed in three patents: Metheny & Browar used a high chromium content steel for the container and added traces of lead;[170] Jendrzynski[171] added molybdenum to inhibit bath decomposition; and Ramirez[172] claimed the elements from Group Va of the periodic system. An *alkaline bath* was disclosed by Puls & Vincent.[172A]

Concluding the subject of nickel plating, mention should be made of articles, by Cook[173] on *heavy deposits* for missile parts; by Osman,[174] who described *automatic additions* of chemicals to maintain constant conditions in electroforming; and by Silman,[175] who discussed the factors affecting *deterioration time* of nickel-chromium deposits.

COPPER:

In his series of articles on chemistry for electroplaters, Serota reviewed various aspects of copper plating, [176,176A] while Passal published a history of the subject,[177] and patented the use of saccharate to improve *anode efficiency* in cyamid baths.[177A] One patent on *electroless copper* was granted to Cahill & McConnell,[178] who employed formaldehyde and a complexing agent, and Saubestre detailed the chemistry of the process.[178A]

Surprisingly, *acid copper plating* received as much attention last year as did cyanide copper. *Direct deposition* from acid baths without use of an underplate to prevent immersion films were reported by Antropov,[179] who added a small amount of tribenzylamine and thiourea to the bath, and by Strauss,[180] who pickled first in inhibited acid, then immersed the part in the plating solution without removing the acid film. *Addition agents* were the subject of reports by Ke, Hockstra, Sison & Trivich,[181] who determined that thiourea interferes with the crystal growth of the deposit, and by Domnikov,[182] who described Russian production of bright, *non-brittle deposits* from baths containing thiourea, by added naphthalene disulfonate to reduce brittleness. Bertorelle, Bellobono & Scarati,[182A] studied *leveling* with complexing agents. Patents on *addition agents* were issued to Castellano,[183] to Brown & Fellows,[184] and to Van Oosterhout.[185]

Cyanide copper plating developments were found mainly in the patent literature, with only a single article appearing during the year, which is a record of some sort. In this article Laue suggested use of alizarin to remove *chromium contamination*.[185A] One grant, to McLeod & Swalheim[186] claimed the addition of stannous ions to a bright solution to reduce *hexavalent chromium contamination*. The others, all on *brighteners*, consisted of two to Passall[187] for selenium and tellurium dithiocarbamates; two to Foulke, Kardos & Koretsky[188] for compounds of these same two metals plus *acetylenic materials;* and one to McCoy, for cobalt and nickel in small amounts plus a *lutidine*.[189] Nobel & Ostrow claimed an *increase in bright range*[190] by adding NO_3, NO_2, and NO radicals, while McLeod used potassium bromate to maintain the proper *selenide ion concentration* in selenium-brightened baths.[191]

CHROMIUM:

Developments in this field, reported in the literature, appeared exceptionally meager. Rousselot & Rousselot[192] concluded their findings on the *effects of impurities in bright nickel baths* on the covering power of subsequent chromium deposits, and Smart[193] summarized work carried out in England and in this country on chromium plating in relation to the *corrosion resistance* of nickel-chromium deposits. Seyb & Rowan showed, by various corrosion tests, the advantages of thicker chromium deposits from *crack-free* baths,[194] while Weinberg & Brown patented a *composite plate* consisting of chromium-nickel-chromium in specified thicknesses for enhanced corrosion protection,[195] and Stareck & Seyb[195A] claimed a *crack-free* bath, using sulfate and fluosilicate catalysts.

Other articles comprised a survey of *solutions and equipment* for chromium plating, by Weimer,[196] and a comparison by Freidberg[197] between round and flat *lead anodes*. Also, Graham[197A] disclosed a low current density *black chromium* process; Williams & Hammond confirmed the effects of shot peening and grinding on *fatigue strength* of chromium plated high-speed steel,[197B] and Brown & Weinberg[197C] described outdoor corrosion results with *chromium-nickel-chromium* plate.

Although more information was published on alloy deposits last year than in any previous year we can remember, only one paper concerned itself with *brass*, a report on the determination of optimum conditions, by Sree & Rama Char,[198] for the *pyrophosphate* bath which, incidentally, gave good results only on a rotating cathode.

Tin alloys accounted for most of the activity, with *copper-tin* and *zinc-tin* sharing the honors. In connection with the former Lee[199] discussed the *operating variables* of the modified stannate bath for various

alloys; Ramanathan[200] determined the *hardness* of a number of alloys with the diamond pyramid instrument; and Bride, Faust & Safranek[201] patented a *pyrophosphate* bath containing lead and aliphatic carboxylic acid salt additions. *Tin-zinc* was the subject of three patents; to Saubestre[202] for gelatin and molybdate addition agents for the caustic-cyanide bath; and to Saubestre & Araunt[203-4] for improved baths of this type. The different, *solderable* tin alloy coating were compared by Howard & Rogers.[205]

The literature also turned up a variety of other alloys. Literature reviews were compiled by Levy for for *chromium alloys*,[206] by Briggs & Schultze for *molydenum alloys*,[206A] and by MacNamara, for *manganese alloys*.[207] McGraw, Gurklis & Faust[208] investigated *chromium-alloys*, obtaining banded structures from acid solutions of chrome alum and ferrous ammonium sulfate; and a study of *cobalt* alloyed with chromium, tungsten, or molybdenum also showed banding in almost all cases, according to Fassell & Bauer.[209] *Tungsten-molybdenum* alloy progress was surveyed by Safranek & Vaaler.[210]

The use of citrate baths to produce alloys of *nickel* with up to 75-80% copper was described by Priscott,[211] and the pyrophosphate bath by Rama Char.[211A] A patent was obtained by Brown for the deposition of an alloy of nickel with cobalt or iron over a bright nickel base.[212]

CADMIUM & ZINC:

The limited material published on cadmium plating was concerned mainly with elimination of *hydrogen embrittlement*, although one article, by Boxall & Hallowes,[212A] presented data which indicated absence of diffusion into copper. Vlannes, Strauss & Brown[213] found that aliphatic amino acids as *complexing agents* in alkaline baths produced deposits with less embrittlement than those from the cyanide baths. Various *non-cyanide* solutions, containing glycinate, methanol and triethanol amine were described. Cash & Scheuerman[214] were able to plate high strength steel without embrittlement by producing a *porous cadmium* deposit from a regular cyanide bath, without brightener, which did not act as a barrier during the subsequent hydrogen-relief bake. Calderon suggested a *plating cycle* which avoided embrittlement,[215] and Hamilton & Simon patented a *non-embrittling* cyanide bath containing nitrate and an alipathic amine.[216] *Brightener* patents consisted of one for the acid fluoborate bath to Westbrook,[217] one to Taverna for a cyanide bath,[218] and one for a substituted phenyl ether which Levy claimed to be suitable for zinc cyanide solutions also.[219]

One *zinc brightener*, for acid solutions, was disclosed in a patent issued to Safranek & Miller.[220] Of the five articles culled from the technical literature, two dealt with the cyanide bath: a *review* of zinc plating by Horvick,[221] and another, by Buckley,[221A] reviewed *uses and application* in a comparison between cadmium and zinc. In the other three articles, Rama Char[222] obtained good deposits from *pyrophosphate* baths, which have some advantages over the cyanide types, Povey & Marx[222A] reported on a *pilot plant* using this bath, and Sato investigated *crystal growth* of deposits from an acid sulfate bath, with and without organic colloids, using electron diffraction and electron microscope methods.[223]

MISCELLANEOUS METALS:

Parker presented a review and history of precious metal plating,[224] and one article each appeared on gold rhodium and palladium deposition. Aves described *thermal-decomposed gold* and displacement coatings for missile and aircraft problems;[225] Rhoda & Madison[226, 226A] disclosed a new *electroless process for palladium*, using an alkaline metal amine complex, hydrazine as a reducer, and E.D.T.A. as a stabilizer; and, in a study of the effect of addition agents on *stress and cracking* of *rhodium* deposits, Reid determined that aluminum and magnesium eliminated cracks without stress reduction, and selenic acid added to the sulfate bath resulted in closing of cracks in thicker deposits.[227]

Patents on precious metals were varied as to subject also. Rinker & Duva claimed a *bright acid gold* consisting of gold cyanide, an organic acid and a base metal salt;[228] Dobbs, Gill & Howes[229] disclosed an *immersion silver* method for copper which employed an acid sulfide-thiourea bath; and Schumpelt was granted two patents on production of *low-stress rhodium* deposits from the sulfate bath, containing magnesium sulfate and sulfamate.[230] Schumpelt also received another on a composite deposit of *gold over silver*, with a thin barrier layer of a platinum group metal between them,[231] and Schnable suggested a method of *gold plating* semi-conductors.[232]

Tin accounted for only one article, in which MacIntosh[233] reviewed the various plating processes. Four patents were granted; Higgs & Owen claimed a *sulfamate bath* containing an addition agent,[234] Ceresa & Drobne[235] disclosed an *immersion tin salt* for copper, Nelson[236] a *flowing oil* comprising palm oil and pentatriacontenyl succinic acid anhydride, and Smith & Smith[237] improved the yellow *discoloration resistance* of tin by anodizing, then treating cathodically in a solution of dihydrogen phosphate and nitrate.

In connection with *deposition of aluminum*, Utz & Kritzer discussed high-purity deposits from the nonaqueous diethyl ether bath,[238] and patents were granted to Doumas & Murphy[239] for a solution of aluminum chloride in an alkylamine and an alipathic ether; and to Linden,[240] who claimed an *aluminum-containing* deposit from an aqueous acid aluminum sulfate bath.

Miscellaneous subjects included a review of *fluoride plating baths* by Kappanna & Talaty,[240A] an article by Petrov[241] on the structure and wear resistance of *iron deposits* from the hot ferrous chloride bath to which glycerine had been added, and a *lead plating process* suggested by Heiser & Hyde[242] for coating copper bars to be used as *anodes* for chromium plating gun bores. Also, a description of the production of *amorphous silicon* films on bright nickel, by Graham, Pinkerton & Boyd,[243] using a diaphragm; and universal type *organic brighteners*, claimed by Gundel, Strauss & Haas[244] and Strauss & Wedell[244A] to be suitable for nickel, copper, zinc, silver, bronze, brass, and cadmium baths.

Electroforming — Metalizing — Vapor Coating

Interest in electroforming appears to be mushrooming, if we can judge from the number of articles and patents published during the past year. Balmer & Bailey[245] described production of *wave guides*, and patents were granted to Kinnear,[246] and to LaForge, Jr., Neal & Whitehurst.[247] Young & Lamb[248] covered *embossing plates;* Foley[249] *heat sinks* for missile nose cones; and Osman[174] described the maintenance of constant conditions in *nickel electroforming baths* by automatic additions, while Hughes[249A] considered *grain size control.*

Patents galore were obtained on electroforming procedures and articles. Boelter[250] produced *shaped charge containers;* Bingham[251] *metal boot lasts;* Fialkoff[252] *hollow bodies;* Hirsch[253] *rigidized sheets;* Ferrand[254] a continuous belt of *abrasive-bearing* electrodeposited metal; Schaer[255] metal *screens;* and DeRooy & Jonkers[256] *copper grids.* Cunningham claimed a *stripping film* for iron electroforming, consisting of graphite, ethyl cellulose and a solvent for the latter;[257] and Hunting, Rinzema & Overeem[258] disclosed a *suspension rack* for phonograph record blanks.

Very little new developed in the production of conducting films, but one article was of great interest, in which Murphy[259] explained how an adherent film could be produced on *plastics with copper inserts,* by first oxidizing the copper. When the subsequent copper-reduction conducting film was formed, the oxide was reduced and the usual non-adherent scum was avoided. An ammonia-free *silvering process,* using a chelating agent was patented by Wein,[260] and deposition of *electroless nickel* on ceramic particles to form a cermet was claimed by Eisenberg.[261] *Sensitizers* were covered in two patents, one to Saubestre[262] for use prior to electroless copper, and the other to Umblia & Schulze for a method of activating with *stannous ions,* then silvering with a reducer active only in alkaline solutions.[263]

Some aspects of *printed circuit* production were detailed in a symposium on the subject, which included papers by Chaikin, Janney, Church & McClelland;[264] Chaiken, McClelland, Janney & Landsman;[265] Saubestre;[266] Dytrt;[267] and Sharpe & Garn.[268] Among the patents on this subject, Gitto[269] claimed a *production method,* Hauser & Lorenz[270] covered *plating through holes* in the non-conducting board, and Murray & Dyer[271] suggested coating with *tin-lead,* followed by indium deposition and diffusion.

The only article on *vacuum metalizing* worthy of mention was a discussion of *dip dyeing* after finishing, by Perkel.[272] However, numerous improvements were claimed in the patent grants. *Equipment* was the subject of patents to Rodriguez,[273] Schwindt,[274] Patton & Kelly,[275] and Bughee & Boehme,[276] the last for a continuous system for coiled material. Elimination of hydrogen embrittlement on high-strength steel by applying *cadmium* in a vacuum instead of by electrodeposition was disclosed by Jenkins,[277] and an apparatus for applying these relatively heavy coatings was devised by Patton, Kelly & MacNeil.[278] Improvements in *evaporation of the coating* metal were claimed by Barker,[279] and by Gerow,[280] while *aluminum coatings* on black iron, suitable for containers, were covered in patents obtained by Baer, Bugbee & Clough.[281-2]

The fact that there were more than one or two articles on *gas plating and diffusion coatings* was a source of pleasant surprise since, despite the difficulties, the process offers advantages which are being appreciated only too slowly. The outstanding paper, in this reviewer's opinion, was a thorough treatment by Owen[283] of the deposition of *nickel* from the carbonyl, including experimental data on the effects of variables. Samuel & Hoar [284] confirmed the influence of *chromium diffusion* on the oxidation resistance of basis metals, and Samuel also described various types of diffusion coatings.[285] In other papers, Schultze presented a very detailed survey of the deposition of *molybdenum and tungsten* from carbonyl and chloride vapors,[286] and Raymond used molybdenum pentachloride to deposit the metal inside large bore tubes.[287] If a good argument is needed for reform of our country's patent system, it will be found in the patents concerned with this field. Since, in the case of many of the grants, it could take more than a good technical and legal mind to distinguish between prior art and invention, these are listed only in the references, for those who have an especial interest.[288-312]

Conversion Films — Corrosion Preventives

True to form, proponents of conversion coatings continued to produce developments in this phase of finishing at a goodly pace. The *chemistry and characteristics* were detailed by Ayres,[313] and use as a *paint base* was discussed by Gibson.[314] *Phosphate coatings,* in particular, were treated in a review and survey by Spencer;[315] and in a discussion of developments, with reference to *preparation for painting,* by Shaw.[316] The increase in *corrosion resistance* of painted and unpainted zinc and cadmium as a result of phosphating was confirmed in an investigation by Knanishu.[317] Solution patents consisted of *pretreatment* with a sodium phosphate containing a titanium compound, in order to activate the surface, claimed by Cavanagh & Maurer;[318] use of an *iron phosphate* bath, followed by a rinse in concentrated chromate, which is allowed to dry on, disclosed by Russell & Gibson;[319] an acid solution of *alkali metal nitrate and pyrophosphate,* suggested by Rausch & Werner;[320] and a combination *cleaning-phosphating* bath, compounded by Smith.[321] A bath and process for *coating wire continuously* was devised by Wilkinson, Jenkins, Lake & Radcliffe.[322]

Chromate coatings appeared to interest as many authorities as did phosphate films. Fishlock compiled a survey of the subject,[323] and the *mechanism of zinc passivation* was studied, along with the part played by soluble chromate, by Rajagopalan & Balakrishnan.[324] Odone & Milanese[325] developed a very satisfactory solution for *continuous hot-galvanized steel,* consisting of chromic acid with a small amount of sulfuric acid and wetting agent, while Melse & Baeyens, in a report on their study of *silver and copper passivation,* pointed out the necessity for pH control in the alkaline chromate solution.[326] Among the patents, Bell[327] claimed a solution of *hexavalent chromium and polyacrylic acid,* which is heated, after application, in

order to insolubilize the film. Solutions for *magnesium* were disclosed by Whitby,[328] for *zinc* by Jeremias,[329] and for *non-ferrous* metals by Schuster & Baldi.[330]

Mixtures of chromate, phosphate, and other compounds were also covered in the year's literature. Wick & Reed made a depletion study of the *Cr-22 process for magnesium*,[331] and Evangelides received another patent on his *electrolytic process* for this metal.[332] For *aluminum*, Halpert patented a solution of chromate, phosphate, and fluoride,[333] Newhard & Dollman controlled this type of bath by *ion-exchange and replenishing additions*,[334] and Pryor[335] eliminated *solution entrapment* by an after-rinse in a solution of a reducing agent. Other patents included one to Dell for an improvement in triple-threat bath of *chromate-phosphate-fluordide*, and another for application to iron of a dichromate-phosphate solution containing a reducing agent, which Curtin[337] heated to form a microcrystalline *chromite-phosphate* film.

The patents disclosed a number of miscellaneous chemical compounds; Pibley used lithium, a fluoride, and an anion from Group VI-a of the periodic table for *aluminum*,[338] also a compound of carbon linked to an oxygen or sulfur molecule;[339] Singer claimed an ammonium thiosulfate bath for *iron;*[340] McDonold[341] suggested a conversion coating compound containing a *polymeric* material with a polar grouping; Ross[342] a solution of benzoic acid and dihydrogen phosphate for *aluminum;* and, for this same metal, Milliken exposed the surface at elevated temperature to *organic fluoborate*[343] and to *boron trifluoride*.[344] On *volatile corrosion inhibitors*, only one patent was issued, to Murray for a material which is formed in situ,[345] but the usually large number of grants were made on *hydrocarbon* and other organic *corrosion preventives*.[346-59]

Testing and Control

Articles on testing and control were about evenly divided between the solution and the deposit. Modern methods for *chemical control* of plating solutions were reviewed by Langford,[360] who also emphasized the need, and a comparison of the ferrocyanide and E.D.T.A. methods for *zinc and cadmium*, by Rosenberger & Shoemaker,[361] confirmed the superiority of the latter. *E.D.T.A.* was also employed as a reagent by numerous researchers. Langford used it for determining *lead* in plating solutions, with xylenol orange as an indicator;[362] Armet[363] determined *copper and zinc* in a single sample of *brass solution*, with thiosulfate for the former and E.D.T.A. for the latter; and Konishi suggested a volumetric method for *sulfate in chromium solutions*.[364] It should be added here that Ducey & McKinley[365] found cooling of the *chromium* solution below plating temperature results in loss of soluble sulfate and affects the analysis.

Other articles on analytical methods included procedures for nitrogen, free ammonia, metal, boric acid, and trisulfonic acid in *sulfamate nickel baths*, suggested by Bush & Higgs;[366] ingredients of *copper baths*, surveyed by Serota,[367] and nitric acid and ammonium bifluoride in aluminum *chemical polishing* solutions, by Scott.[368] Mohler detailed methods for titrating sulfuric acid *anodizing baths*,[369] and specific gravity control methods for the acid and aluminum sulfate contents,[370] and for *Watts nickel*.[371] The ingredients of *alkaline derusters* — cyanide, caustic and chelate — were covered by Doss,[372] and an evaluation of the cyanogen chloride method for *chlorine in waste waters* was made by Katz & Heukelekian.[373]

In the transition area, where the solution is controlled by *examination of the deposits* it produces, Such[374] detailed this procedure and Mohler described the different types of *plating cells* for this purpose and their operation.[375] A *modified Hull cell*, with properly drilled holes, enabled Branciaroli[376] to use higher amperages without temperature changes, and an improved *test cell* was patented by Gilmont.[377]

Thickness testing was covered in only one aritcle, by Goodwin & Winchester[378] on continuous x-ray measurement, and in one patent, to Hanysz & Saur[379] for an *electronic apparatus*. Physicals were treated in articles by Read & Whalen[380] on a *ductility* test method; a "push-out" test for *adhesion* of thick deposits, suggested by Chessin & Poor;[381] and refinements in the construction and use of the Brenner & Senderoff *stress apparatus*, developed by Fry & Morris.[382] Five *optical methods* for studying surface finishes were described by Heavens.[383] In articles on *aluminum oxide films*, Deal presented an *abrasive jet* method for determining the resistance of thick anodic coatings,[384] while Bury & Godard[385] determined the *degree of sealing* of the film by measuring the weight gain upon resealing. *Porosity* was also the subject of three more articles. Ogburn & Ernst[386] used parallel sectioning for microscopic detection of pores in *nickel deposits* and, with Roberts,[387] determined that the *Ferroxyl test* detects less than 50% of all pores in *gold deposits* on steel. An interesting *anodic porosity test*, described by Clarke & Britton,[388] depends on the electrical resistance of the electrolyte in the pore channels.

Accelerated corrosion tests have been developed to overcome the limitations of the salt fog method, and the newest ones were not neglected in the literature. The *copper-acceleratd, acidifid salt spray* method was described by Sukes,[389] and by Nixon, Thomas & Hardesty;[390] the *sulfur dioxide* test by Edwards;[391] and the *Corrodkote* test by Bigge.[392] Dettner, in a *comparison of the corrosion resistance* of zinc, cadmium, tin and tin-zinc,[393] employed salt spray, humidity, sulfur dioxide, and outdoor exposure with interesting though confusing results, which showed that the *type of test* is quite important. LaQue discussed *corrosion testing*,[394] and a *humidity tester* was patented by Dieman.[395]

Waste Treatment

Steel plants must be fairly well satisfied with their present methods of handling *pickling wastes*, as the literature turned up no articles during the year worth reporting and only three patents, to Chang[396] for a *cyclic process* of regenerating the acid values, producing iron powder by gaseous reduction; to Francis[397] who precipitated the *ferrous sulfate* and recovered the acid; and to Muns & Berkebile,[398] who treated with *raw coke oven gas* to precipitate the iron.

Various phases of waste treatment and recovery were covered in print, the most original method being *dialysis*, described by Dvorin.[399] Justh reviewed treatments for different types of *metal finishing wastes*,[400] Heidorn

& Keller[401] restricted their discussion to *ion-exchange* methods, and Gabrielson[402] described this method for purification of *chromic acid baths*. Utilization of waste heat to recover wastes by *evaporative concentration* was detailed by Swanton,[403] and Zievers & Riley[404] reviewed the methods for *handling the sludges* produced during treatment, while Beals covered the subjects of *alkaline chlorination* of cyanide and *sulfur dioxide reduction* of chromium.[405] In a study of the toxic effects of metal ions on *sewage micro-organisms*,[406] Malaney, Sheets & Quillan found that, after a period of inhibition, the organisms became acclimated to the metal ions.

In other articles on the subject Milne outlined organization for *liquid waste control*,[407] and Day presented a general review of *Methods of treatment and disposal*,[408] while commercial *installations* were described by Mikos & Szkudlapski,[409] Hanson & Zabban,[410] and Winger,[411] the last employing ion exchange.

Miscellaneous

In an investigation of the effect of *gas bubbles* on pore formation in deposits, Ogburn & Ernst[412] constructed a new cell which permits observation while the pit is being formed. *Micro-throwing power* was studied by Garmon & Leidheiser,[413] and Lawless, Lardenoit & Cohen[414] determined that the *endurance limit* of chromium hot-work tool steel was lowered drastically by plated, sprayed, or dipped metallic coatings. The limit was restored by *shot peening and nitriding*. *Current distribution* problems could be solved by *analogical methods*, as described in a paper by Rousselot.[415]

There is not much to offer in the way of *barrel plating* developments. In the single article, Wallbank[416] discussed the subject with special consideration to *protecting thread diameters*, but there was an interesting article on *basket plating*, by Marotta.[416A] Patents were granted to Singleton & Gill[417] for a *barrel*, to Bikales[418] for a *feed device* for continuous production, and to Hoffman[419] for a *switching unit*. Improvements in *rack design* were patented by MacLean,[420] Henson,[421] Nali,[422] Gutzmer,[423] and O'Connor,[424] while *automatic plating machines* were claimed by Borodin,[425] Lancy,[426] Swenson,[427] and Davis.[428] *Wire plating* covered two grants, to Bachman,[429] and to Summers & Hasell,[430] and other machines included one for plating closed *slide fasteners*, designed by Cohn,[431] and another for *strip plating*, disclosed by Egge.[432]

Other electrical developments were a *plating tank connector*, patented by MacLean,[433] and a few articles on *rectifiers*, in one of which Schneiders[434] described a simple, inexpensive meter for *testing* A.C. ripple. In the others, Cataldo compared the *silicon* and *germanium* types,[435] Stewart described *rectifier progress*,[436] and Schore[437] suggests *suitable types* for the different electrolytic finishing operations.

There were a number of miscellaneous articles on plating, which are reported here because of difficulty in classifying. Tomlinson[438] described the old process known as "*close plating*," Modjeska & Gary[439] covered use of electrodeposits as *resists in selective heat treating*, Spencer surveyed the *engineering uses* of plated coatings,[440] and Wernick[441] reviewed the problems encountered in the application of *pre-finished* metal. The corrosion resistance of *copper-nickel-chromium* was evaluated by DuRose & Pierce,[442] and some aspects of the *corrosion of decorative coatings* were discussed by Lowenheim & Rowan.[442A] Patents were obtained by Zimmerman for a *jet plating* method using an E.D.T.A. bath,[443] and by Saubestre & Bulan[444] on a method of *increasing plating speed* in cyanide-hydroxide baths by adding gelatin, glycerine, and ammonium molybdate.

Stripping of deposits accounted for one article, in which Beck, Danovitch & Ketcham[445] compared HF-HNO_3 baths with the commonly used H_3PO_4-HNO_3 strip for oxide films from *anodized aluminum*, and three patents, one to Kolodney for removing deposits from *plutonium*, and the other two to Jaffe for low melting metals from *copper and aluminum*.[447] *Coloring* was covered by an article reporting the studies of Srivastava on *black oxide* finishes for steel,[448] and a patent by Mason on blackening *copper*.[449] Other surface films were treated in a patent to Carrigan for *passivating* stainless steel,[450] and in an investigation by Fry & Whitaker[451] on formation of hard *anodic films on zinc* in caustic-carbonate baths, and in silicate-borate baths.[452]

There were three articles on *filtration*, a description of pressure filters and their operating characteristics by Gray,[453] a discussion of the *engineering aspects* of solution filtration by Borlet,[454] and details of *diaphragm construction* for plating tanks by Newman.[455] *Electrolytic purification* with preliminary use of a plating cell to determine current and time was the subject of an interesting article,[456] and the addition of specified *chelating agents for impurities* in bright acid solutions was patented by Kirsthler, Willmund & Strauss.[457]

A nomograph for calculating *weights and loads* of metal bar parts was prepared by Field;[458] general equations, test panel and copper coulometer methods for determining *plating time* were presented by Duffek;[459] and a method of plating to *controlled deposit thickness* was patented by Varner.[460] Other articles included discussions by Spicer[461] on *heating*, by Fishlock[462] on *anodes*, by Panikkar[463] on *shop layout and installation*, and by Corfe[464] on *trouble-shooting* in the plating room.

General subjects treated in the finishing literature during the past year included *cost breakdown* and their recovery,[465] by Turner; *depreciation*, by Elbaum;[466] *method and motion study*, and the application of the principles of industrial psychology to the smaller plating shop, by Ollard;[467] *inventions and patents*, by Seidel;[468] the first part of a survey of *metal finishing in Europe*, by Marino;[469] and the usual *review of the literature*, by Hall,[470] for the busy finisher who had no time during the year.

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257. G. L. Cunningham. U.S. Pat. #2,880,147 (Mar. 31).
258. B. J. Hunting, A. Rinzema & H. Overseem. U.S. Pat. #2,890,160 (June 9).
259. E. B. Murphy. Plating, **46**, 828.
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261. P. H. Eisenberg. U.S. Pat. #2,872,312 (Feb. 3).
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263. E. J. Umblia & E. A. Schulze. U.S. Pat. #2,879,175 (Mar. 24).
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273. C. Rodriguez. U.S. Pat. #2,883,959 (Apr. 28).
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295. H. A. Toulmin. U.S. Pat. #2,881,518 (Apr. 14).
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314. R. C. Gibson. Proc. A.E.S., **46**, 93.
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319. W. S. Russell & R. C. Gibson. U.S. Pat. #2,882,189 (Apr. 14).
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321. C. W. Smith. U.S. Pat. #2,886,477 (May 12).
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332. H. A. Evangelides. U.S. Pat. #2,880,148 (Mar. 31).
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337. L. P. Curtin. U.S. Pat. #2,901,385 (Aug. 25).
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363. R. C. Armet. Electropl., **12**, 56.
364. S. Konishi. Metal Finishing, **57**, 61 (Feb.).
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367. L. Serota. Metal Finishing, **57**, 77 (Oct.).
368. B. A. Scott. Electropl., **12**, 369.
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385. D. E. Bury & H. P. Goddard. Electropl., **12**, 219.
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391. J. Edwards. Proc. A.E.S., **46**, 154.
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400. R. Justh. Electropl., **12**, 11, 47.
401. R. F. Heidorn & H. W. Keller. Prod. Fin., **23**, 72 (Mar.).
402. G. Gabrielson. Met. Fin. J. (Br.), **5**, 19.
403. W. F. Swanton. Plating, **46**, 919.
404. J. F. Zievers & C. W. Riley. Plating, **46**, 924.
405. J. L. Beals. Plating, **46**, 922.
406. G. W. Malaney, W. D. Sheets & R. Quillan. Sewage & Ind. Wastes, **31**, 1309.
407. D. Milne. Sewage & Ind. Wastes, **31**, 447.
408. R. V. Day. Plating, **46**, 929.
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413. L. B. Garmon & H. Leidheiser, Jr. Proc. A.E.S., **46**, 50.
414. G. W. Lawless, V. F. Lardenoit & B. Cohen. Plating, **46** 1264.
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454. C. G. Borlet. Plating, **46**, 932.
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459. E. F. Duffek. Metal Finishing, **57**, 77 (Sept.).
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462. D. J. Fishlock. Metal Finishing, **57**, 48 (Feb.); 55 (Mar.).
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464. C. F. Corfe. Electropl., **12**, 291.
465. S. Turner. Met. Fin. J. (Br.), **5**, 47.
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467. E. A. Ollard. Electropl., **12**, 79.
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Organic Finishing Developments of 1959

By Daniel A. Marino, *Asst. Technical Editor*

Adhesion

A NEW method which provides a simple yet precise means for measuring the wet-adhesion, or abrasion-adhesion, of various coatings was described in the literature.[1] The method provides a pebble mill charged with a specified amount of pebbles and quartz abrasive in a liquid medium.

In a summary[2] of observations of factors influencing adhesion of organic coatings to chromium plated surfaces, it was reported that adhesion is poorer on chromium plated directly on copper without nickel than on chromium plated over nickel.

Application Methods

It was shown by Zahn[3] that refinements in flow coating, such as by use of improved vapor tunnels, have in many cases virtually eliminated top-to-bottom gradient in film thickness. Similar flow coating operations[4] are being conducted on missile parts.

Dip coating systems[5] for entire automobile bodies was reported to have solved serious corrosion problems. Weed[6] indicated that use of slower drying solvents may eliminate stratification in dip coatings. Numerous developments in the field of electrostatic spraying attest to the continuously growing popularity of the process.[7-12] Other types of automatic organic coating processes[13,14] were also found in the literature. MacArthur and Way received a patent[15] for an automatic machine operated solely by fluid pressures for controlling the spray painting of articles.

It was found that hot spraying of vinyls will reduce the number of coating applications required to prevent pinholing.[16] Levey received a patent[17] for a hose type paint heater which may extent the useful characteristics of hot spraying.

Fluidized coatings continue to make news, both in the technical[18,19] and patent[20] literature. Such coatings are often applied by dipping pre-heated parts into specially prepared powder then placing them in a moving matrix of the powder, the motion of which is controlled by a current of air or gas within a tank designed especially for the process. The parts are then post-heated above the melting point of the resin. This is designed to thoroughly fuse all particles sticking on the surface.

Numerous interesting topics were discussed at the Society of Vacuum Coaters 1958 Technical Conference which was held in Detroit on November 6, 1958.[21-26] Since affinities of two or more dyestuffs in solution frequently vary, Perkel[27] recommends using single color dyes for dip dyeing vacuum metalized coatings.

Color

Hammond[28] mentioned in a talk that even though spectral characteristics of porcelain color standards used to control paint color are oftentimes quite different from the paint itself, because they are so permanent, they may be and are used effectively. He indicated that by using such standards one can consistently come back to the same "benchmark" each time. Measurement of colored porcelain standards against a white background will help evaluate how far off the colorimeter is from the ideal and whether anything is changing with time.

Beck[29] reported that if appropriate color stabilizers were not available, it is doubtful whether polyvinyl chloride could have achieved its ever widening usage. One[30] automotive paint sprayer has found that in order to insure reliable color matching, new color standards should be issued every six months. In an elaborate study[31] of color preference and subjective color structure with regard to theory and methodology, one proposal put forth was that one's preferences in colors is related to a standard in that person's head. The color need not be in the same class from which he is making a selection.

Conversion Coatings

Although the technical literature was not as active in the field of conversion coatings as it has been in some of the other recent years, 1958-9 saw increased activity in the patent[32-42] field which more than made up for this tempered writing[38] activity.

Numerous patents were received for various phosphate as well as chromate coating systems. A patent[43] was obtained for an oxalate conversion coating used for treating stainless steel to improve drawing operations.

Equipment

In discussing spray booths, Weed[44] stated that the use of water wash types improve working conditions, reduce maintenance costs and fire hazards, and in general make the plant a cleaner, safer place in which to work. Valuable floor space was saved by a large Ohio manufacturer when he placed his spray booths and oven on high stilts.[45] Another company found that by using traveling spray booths, they are able to economically spray railroad cars.[46] Both the automatic and manual spray booths of this railroad maintenance shop are now completely integrated, being self-propelled with air wash exhaust system, water pump, exhaust fan, lighting as well as built in fire extinguishing system. Railroad cars are spray painted in nine minutes.

Hot spraying and electrostatic spraying continue to gain in popularity in Russia as plant investment for painting facilities increased sharply in the last two years.[47]

It was shown[48] that vinyl plastisols with unusually

high solids contents can be made to spray satisfactorily by incorporating an air agitator and pump to keep the effective viscosity at a minimum.

Among many patents[49-54] received for spray painting equipment were a paint mixing device[52] and a paint transfer tank.[53] The latter will permit using the original container for the paint feed tank. Another patent[54] was granted for a device which proportions standard color ingredients for producing a predetermined quantity of color mixed paint.

Materials for Coatings

Pigment studies received much attention in the technical[55,56] literature. Varley[57] pointed out that pigments are expected to withstand more rigorous specifications with regard to resistance to light, heat, and chemicals and yet to be easily dispersible. Beck[58] pointed out that the stabilizer of today is added solely for its value in reducing undesirable changes in a coating unlike in the past when pigments with stabilizing effects were considered as having the necessary beneficial side benefits.

It was reported[59] in the Russian technical literature that, of the various drying oils, those having the most resistant coatings were based on glycerol phthalic and styrene vehicles. The lithopone paints made poor showings in outdoor corrosion tests, particularly when the medium used was based on castor oil, glycerol phthalic or pentaerythritol phthalic.

Epoxy resins, although by now well established in the industrial coatings field, continue to show additional beneficial properties. Barokan[60] examined their relative merits as corrosion preventive coatings and found them useful either with or without the incorporation of corrosion inhibiting pigments.

Paints containing radioactive isotopes were investigated by Morley[51] to determine their effects upon the attachment of fouling organisms. Using the beta emitter thallium 204, he found that fouling was inhibited by a radiation of 20 rad/hr. but not at 2 rad/hr.

Furane coatings, though reported as effective toward increasing the chemical resistance of items, to date are somewhat expensive.[62]

MILDEWCIDAL COATINGS:

Mildewcidal paints received attention in the literature.[63-65] In discussing these materials, Beck[63] indicated that a more positive approach is now being taken for controlling the growth of fungi and bacteria on paint in the last few years. Since many types of mold growth normally appearing on paint look so much like ordinary dirt collection, identification of the cause of early paint failure has been a perplexing problem. Studies in patterns of growth have enabled accurate determination of the difficulty and methods of combatting same. It was further pointed out by Beck[65] that self-sanitizing paints, which contain mildewcides, not only inhibit the growth of molds and bacteria on or within the paint, but also exercise a killing action on bacteria and molds.

WATER BASE PAINTS:

Again in 1959 the technical[66,67] and patent[68-70] literature carried many references to water base paints. In an article discussing one of these types, water soluble, Arne[71] pointed out that solution technology of water soluble coating materials is in some ways less tricky than that of emulsion types. Viscosity of polymers in latex form is independent of polymer molecular weight or composition, while resins applied from solvents must be limited in molecular weight and composition to achieve solvency and reasonable viscosity. Arne further mentioned that another possibility for technical shift in the water base paint field is that a new material, probably a copolymer of one or more of today's monomers, will become popular. Hollis[72] suggested a low cost water base paint formulation based on petroleum resin modified polyvinyl acetate homopolymer.

URETHANE COATINGS:

Polyurethanes continue to become more generally used both in the United States and other parts of the world as news of further improvements in both their formulations and methods of application spreads.[73-81] Since the isocyanates (primary building blocks of the urethane system) may be reacted with many types of familiar vehicles to create entirely new products of potential value, interest is being directed to new combinations and new applications for profitable development.[77] Suggestion is made by Wells[79] to formulate urethanes possessing emulsion systems. Such a system will eliminate fire hazards which solvent base paints exhibit.

Silicone resins, because of their excellent resistance to heat, weathering, and many chemicals continued in 1959 to increase in popularity in the coatings field.[82]

An organic coating system was described in the patent[83] literature which, it is claimed, is a hard, adherent, crack-resistant, multi-layer coating. The primer has as its principal organic film-forming material an esterified epoxyhydroxy polyether resin while the second is a superimposed layer of methyl methacrylate lacquer. A patent[84] was also received for a red lead composition which, it is claimed, has improved flowing properties.

Writing a specification for an organic coating material often repays itself many times in fewer rejects, consistently higher quality and uniformity and, in many cases, because of competitive bidding, less expensive material costs. Heyson[85] described a typical specification for an organic finish and showed that a careful description of the expected requirements for a finish material plays an important part in the over-all success of a product.

Safety and Hazards

Preuss[86] indicated that both in this country and abroad people are becoming more health conscious. Although much regulatory legislation is on various state and national books for foods and drugs, until recently relatively little control was present for other products. He suggested that a method of keeping up with the new legislation is by subscribing to an expanding looseleaf notebook* published by the National Paint, Varnish and Lacquer Associations which is sup-

**Labeling Laws and Regulations*, National Paint, Varnish and Lacquer Association, 1500 R. I. Ave. N.W., Washington 5, D. C. $2.50.

plemented from time to time with pages describing new laws as they come into being. Broadhurst[87] instructed that flammable solvents, toxic dusts, and moving machinery all constitute potential dangers to operators in the surface coatings industry. He further stated that, as new materials and types of equipment are introduced, a constant challenge must be met by management to ensure safety in the shop.

Specialized Coatings

Plastisols and organisols again received much attention in the literature[88,89] of the past year. Maines[88] pointed out that, because of their inherent flexibility, vinyl dispersion resins may be applied in thick films without fear of embrittlement and cracking.

Improved fluorescent paints,[90] particularly with regard to longer useful life properties, have expanded their engineering uses. One government agency has found that using fluorescent paints on aircraft used for training purposes has reduced mid air accidents by 75%.

Fire retardant paints and materials for them continue to be reported in the literature. Phosphopolymers, described in two British patents,[91,92] when burned leave an adherent porous or foamed carbonaceous char which protects the basis material from further burning to a large extent. It was also shown[93] that durable fire retardancy for both indoor and outdoor paints can be obtained through the use of isano oil. The oil, which has the ability to give off a gas that expands the paint film which heated (intumescence), proved to help fire retardancy on all of six counts in burning tests.

More attention is being paid to polyesters for coatings purposes.[94,96] Yeates[94] indicated that polyesters with their good chemical resistant properties will become more popular as better application methods are developed. Bobalek[96] suggested that where a polystyrene disperse phase is present in a styrenated alkyd and it is the more rigid polymer with a particle size sufficiently small, the disperse may provide a reinforcing effect similar to that of carbon black in rubber compounds. In pointing out the many advances made toward improved coatings in the last decade, Kanning[97] mentioned that sulfonated polyethylene materials are being used in paints primarily for their exceptionally good chemical resistance.

It was reported[98] that a recently developed insulating varnish will easily withstand the centrifugal forces and high armature temperatures in many of the newer lightweight motors being designed today. A patent[99] was received for a silicone containing high temperature resistant enameling paint for producing a vitreous enamel anti-corrosion coating on ferrous metal shapes at elevated temperatures. Numerous other developments[100] in the vitreous enameling field have led to a great variety of finishes having special effects. Marbelizing, veining, and stenciling types of porcelain enamels were reported in the literature of the past year.

Industrial finishes of the water base types continue to receive considerable attention.[79,101,102] Numerous varieties of these materials, primarily based on styrene and butadiene copolymers, have become very popular for primer coatings. Johnson[101] points out another economy in the use of water base primers in that large quantities of air (in winter, room heat) need not be exhausted in order to maintain the evaporating solvent below (the maximum allowable limit and) the explosion limit. Among other similar patents, one was granted for an oil-free water dispersed organic coating. Smith and Powel received a patent[103] for a wrinkle finish consisting of a plastic, fusible wrinkling composition. Lederman[104] received one for a wrinkle finish based on rosin modified phenol formaldehyde resin, tung, oiticica, and fish oils.

It was shown by Decker[105] that pearl essences will behave quite differently when different vehicles are used. He indicated that in some instances it is effective to use a pearl crystal which will react chemically with the vehicle while in other instances it is essential that the pearl dispersion be so prepared that the rheological flow permits definite patterns of orientation.

Testing Procedures

Numerous paint testing instruments have become available, among which are: one that will quickly and effectively spread paint films;[106] one that will measure continuously the gloss of a coating as it is made;[107] one that may be used to estimate the sag index of paint films.[108] A number of climatic conditions testing laboratories for evaluating organic and electroplated coatings have been established in the U. S. S. R. in the past year, particularly in Leningrad, Moscow, and Kharkov. In some cases the air is heated and humidified in the chamber itself, while in others it is supplied ready treated and conditioned.[109]

Brightwell[110] dscribed a high precision nondestructive method for determining thickness of organic coatings. The procedure has an average standard deviation of 0.008 mil for coatings 0.1 to 3 mils thick and is applicable to pigmented coatings attached to any reasonably smooth metal substrate as well as to clear films over silicon or graphite. The method is based upon infrared interferometry. Since most pigmented materials are at least partially transparent to infrared radiation, measurement of reflected angle will enable computation of film thickness.

A test procedure for determining water retardant qualities of external coatings was described by Soroka.[111] The coatings were rated on their capabilities to reduce penetration and on this basis, of the coatings-conditions tested, highest water retardant qualities were assigned to silicone coatings in gasoline. Tests[112] of exterior paints showed that modern paint systems based on alkyd resins and some titanium pigments outlast traditional paint systems to a considerable degree. The composition of the priming coat used had only a minor influence on the durability of the paint systems.

Keck[113] found that typical organic finishes exposed to beta radiation increased in hardness and specular gloss.

Wash Primers

Numerous wash primer systems were evaluated[114-118] in 1959. In writing about how paints stand up in

tropical climates, Whiteley[116] reported that wash primers, although very effective when applied properly, cannot be recommended for use in the tropics unless skilled and reliable labor is available. In his opinion, the two package type is too liable to be misused and the one solution type, with a lower degree of corrosion resistance, is liable to deteriorate on storage at the high temperatures found in the tropics. It was found that a phenolic resin modification possesses the greatest range of effectiveness as a wash primer.[118]

Salo received a patent[117] for an etch primer and top coat which, it is claimed, is primarily designed for providing steel with a corrosion resistant finish.

Miscellaneous

Some interesting contributions to the basic understanding of the phenomena which occur during the lifetime of a paint film were reported in a study of the Research Committee of the Federation of Paint and Varnish Production Clubs. The information was compiled and published as a text.[119]

A completely clear, high solids lacquer has been patented which is obtainable in a thixotropic condition for use as a pore filler by the addition of from 5 to 30 per cent of an inorganic aerogel, such as oxide of silicon, aluminum, or titanium to the binder. The lacquer should be completely clear since the refractive index of the aerogel matches that of the binder film.[120]

Attempts were made to measure intensity of odor and their effects upon different individuals. Three stable solids were selected as test materials, namely benzophenone, p-methoxyacetophenone, and diphenylmethane. It was found that different observers reacted differently to a particular odor and differences varied widely depending upon the odors being tested.[121]

It was pointed out by Gaines [122] that multicolor coatings are particularly effective for corrosion prevention when they are applied to a carefully selected primer. Strippable coatings, multicolors, and fluorescent coatings are being marketed in aerosol cans.[123]

Ultrasonic vibrations have been used to induce polymerization where a large surface of monomer is exposed.[124]

In his preliminary report on "Minimum Paint Film Thickness for Economical Protection of Hot Rolled Steel Against Corrosion," Bosch[125] reported it is probable that the conventional conception that steel should be protected with at least five mils of coating(s) might not hold. He found that not only should a minimum paint film thickness be set for the particular type of coating used, but also for the type of surface preparation the material is to be given.

Vinyl to metal laminates continue to find a rapidly growing market. New colors and textures have increased their 'sales-appeal' appearance and more manufacturers are finding that pre-finished sheet stock, in many cases, is less expensive than coating the material after fabrication.[126]

Where parts covered both with paint and rust are being reclaimed, Spring[127] suggests it is best to remove both in certain proprietary alkaline rust removers containing about 2 lbs./gal. alkaline salts at 180-200°F. This permits single bath operation with savings in space, which is quite important since, in most paint shops, paint stripping is usually an afterthought.

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Conversion Coatings

Chromate Films

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DUE to the ability of either chromates or dichromates to inhibit corrosion, a common practice to passivate metal surfaces was the addition of a small amount of these compounds to water. However, where a simple addition cannot be realized, as exemplified by the formation of stagnant water in a carburetor bowl, the use of a chromate conversion coating will perform a similar function. Chromate coatings, which rose to prominence during World War II, can be considered as films generally less than 0.02 mil in thickness. It functions as both a protective, paint bonding and/or a decorative film on such materials as aluminum, copper, brass, magnesium, tin, zinc, cadmium, silver, and the ferrous metals.

Conversion coatings result from simple immersion for a short period in a chemical solution containing either chromic acid or one of its soluble salts along with a source of hexavalent chromium, accelerators, and surface etchants or activators. Other methods of application would include spraying, brushing and, in a few cases, electrodeposition; however, in any event, the resultant coating becomes an integral part of the metal surface. Depending upon the bath composition along with factors such as immersion time, temperature, and pH, the protective coating will vary in quality and appearance.

Film Characteristics

In contrast to the crystalline phosphate film, a chromate conversion coating is amorphous. Directly after formation of the film, care must be taken since the coating is quite soft; however, after rinsing and drying, the film becomes relatively tough and flexible. In the event that the film loses its water of hydration through a drying treatment at a temperature of 150°F. or higher, the hardness of the film increases. Although both resistance to abrasion and corrosion resistance to weak acids and alkalies improve after dehydration, the protective value of the film to water immersion or salt spray exposure is reduced. This reduction in protective value is frequently attributed to the conversion of soluble chromates to insoluble compounds. The above effect varies with both the material coated and the particular treatment selected.

These films can produce a wide variety of pleasing appearances. The basic colors that may be obtained can be conveniently grouped, thus:—(a) Zinc and Cadmium — metallic bright, light iridescent, iridescent yellow, bronze, olive drab, black; (b) Copper, Brass and Bronze — metallic bright, yellow; (c) Aluminum Alloys — clear, iridescent yellow, brown; (d) Magnesium Alloys — metallic bright, iridescent yellow — red, brown, black; and, (e) Silver — metallic bright. In addition, the heavier coatings, as exemplified by the brassy and olive drab types, may be dyed various shades of red, yellow, green, blue, or black; however, since these dyes are not lightfast, their use is limited for indoor exposure or as a means of color coding.

The mechanism effecting the formation of chemical coatings of proper thickness and color is none too well understood. It is believed that an oxidation-reduction occurs, resulting in the formation of a film containing both trivalent and hexavalent chromium complexes plus water of hydration. The hexavalent chromium complex, which is frequently termed the "soluble" portion of the film, is believed to provide resistance to water corrosion. In addition, by virtue of a leaching action of hexavalent chromium, the well known self-healing mechanism is realized. In other words, scratches and abraded areas on the surface will heal and, thus, retain corrosion resistance. In contrast, phosphate coatings are not self healing. The trivalent chromium complex, which is recognized as the "insoluble" portion of the film, is believed to increase coating hardness. It is also believed that the trivalent chromium complex also contributes substantially to corrosion resistance. Thus, Pocock[4] has cited the high corrosion resistance of clear bright films on both cadmium and zinc which contain very little hexavalent chromium. In addition, during the salt spraying of films that contain considerable amounts of hexavalent chromium, the complete leaching of this compound is evident by loss of color[4] and occurs long before corrosion breakdown occurs.

The colors that are obtained with a chromate conversion cycle have also been linked to the coating composition. A typical yellow film formed on zinc by the dichromate-sulfuric acid treatment was found[6] to contain largely trivalent and hexavalent chromium compounds. The chromium in this particular coating is thought to be[10] in the form of either a basic chromium chromate or chromic hydroxide and soluble chromates. Brown or black coatings may contain basic chromium chromates of varying composition,[3] whereas, olive drab coatings on zinc very likely owe their color to trivalent chromium compounds. The colorless films resulting from a leaching process are relatively insoluble films and are thought to contain chromium hydroxide or oxide along with water of hydration.[3]

The corrosion resistance of the chromate film is initially dependent upon the environment to which the coating is exposed. Under a specific set of conditions, other factors that would influence corrosion resistance would include the basis metal that is coated; the bath type chosen; variables of bath operation, such as immersion time, bath temperature, pH of bath and, in the case of electrodeposited coatings, upon the thickness of the plated metal. In general, corrosion resistance will increase with film thickness, but this

factor should not be selected as the sole determinant since those factors given above as well as both pre- and post-treatments have a definite influence. Galvanic corrosion is effectively retarded by a chromate film, and maximum protection is obtained where a chromate film can be applied to both metals that would have provided the galvanic couple.

One of the most widely exploited properties of chromate films is their low electrical resistance. Although this value will vary from one formulation to another, it can be generalized that the resistivity values obtained by this type of film may range from ten-thousands to hundreds of an ohm per square inch of surface area. Chromate coatings have been accepted in the electronic field since their electrical resistance is low enough to be negligible.

On the debit side, chromate conversion coatings have a low resistance to abrasion. A properly dried coating will withstand the abrasion related to press room drawing and stamping operations, but they are readily removed by severe rubbing or harsh abrasion. As mentioned previously, a freshly formed film is quite soft and easily damaged.

Paint Bonding

In considering chromate conversion coatings as bases for organic finishing, the two factors of importance are:—(1) improvement of initial adhesion of the organic coating to the metal and, (2) increased life of the organic coating. Chromate coatings are believed to provide bonding through molecular adhesion. The chromate film is bound to the surface by molecular attraction and, in turn, holds the organic film by the same mechanism.

The chromate films have advantages over other paint bonding coatings which do not in themselves have a corrosion inhibiting effect. The chromate film forms an effective barrier against either corrosive attack through pores or scratches in the organic coating or a reaction between the metal and the organic coating itself. A further advantage is that the films are thin and non-porous, which results in little or no absorption of paint or other applied organic material. This will realize a more economical use of the organic coating as compared with certain crystalline type paint base coatings.

Due to the gel-like, non-crystalline nature of these conversion coatings, the chromate film will not affect the appearance or texture of the paint film, nor will it dust or powder to mar the paint film. In addition, treated parts may be stored for long periods prior to painting without the risk of entrapment of moisture which may cause blistering during painting.

These conversion coatings are used widely with equal ease and success in both baked and air dry paint systems. While the actual adhesion properties of the film do not increase appreciably with thickness, corrosion protection does. As stated previously, the protection given by the film is proportional to its thickness. There are instances where it may be necessary to sacrifice maximum corrosion protection for appearance when a finished part is to be partially painted. As an example, it may be desirable to use a thin, clear bright film if the unpainted areas must present a chrome like appearance. A typical case is that of instrument housings where the exterior is painted and the inside left unpainted. On the other hand, if all surfaces are to be painted, the heavier chromate films should be used when maximum corrosion resistance is required.

Chromate coatings have also been shown to be effective in other bonding applications, notably in the bonding of rubber to metal[4] and as a pretreatment for organic adhesives in metal to metal bonding. An excellent example is the pretreatment of magnesium alloy surfaces prior to the application of an adhesive such as the ethoxyline resin or the phenolic rubber base resin. The chromate bath type employed will depend both on the adhesive and the base metal analysis.

Soldering and Welding

In the event that metal joining operations are to be conducted after the chromate film has been applied to the metal surface, a few generalizations may be given. The ease of soldering is a function of film thickness. Where the chromate film is quite thin, soldering will offer no problem and, in some instances, it may be much easier than that obtained in joining cadmium or zinc surfaces that have an oxide film. Where the conversion coating is relatively heavy, it may be necessary to remove the film in those areas which are to be soldered, particularly where a chloride flux cannot be used. Where the chloride flux can be used, it will effectively remove the conversion coating in those areas to be joined.

In either spot or seam welding, the two procedures normally employed would be (a) penetration of the coating by employing higher welding currents, and, (b) removal of the film by chemical or mechanical means. Chromate films facilitate the shielded arc welding of aluminum.

Application of Chromate Conversion Coatings

Extreme simplicity of operation is one of the attractive features of most chromate treatments. It usually involves a simple immersion with processing times, including cleaning, relatively short. Although there are one or two electrolytic chromate treatments, electrical power is not usually required. Since no fumes are involved in the majority of cases, ventilation is not necessary. Most chromate solutions operate at or near room temperature. Although a certain amount of temperature control is necessary, this factor is never extremely critical.

Flexibility of chromate formulations permits adaptation to a variety of operational conditions. As an example, in chromating plated work in automatic equipment, formulations can be modified to fit a predetermined time cycle. Automatic processing of other than plated work can also be realized by either an immersion or spray application. In other instances, particularly on large work not easily conveyorized, a simple brushing or swabbing of the metal is all that is required.

The steps involved in a typical chromating dip would include:—(a) pretreatment, consisting of the removal of oxide coatings by pickling, and/or the removal of grease, oil and other lightly adherent soil; (b) rinsing; (c) application of the chromate coating; (d) rinsing; (e) dye application when desired; (f) rins-

ing; and, (g) drying. Thorough rinsing in the above cycle is very important; a final hot rinse frequently aids in drying the coating, this being subject to limitations imposed by individual treatments. Drying may also be effected by air blasting, centrifuging, or the exposure of parts to circulating warm air. However, care must be taken so that overheating does not occur, since this may result in lowering the corrosion resistance of the film. Handling of the freshly coated parts is critical, since the films are relatively soft and may be marred easily until completely dried.

Chromate Baths

The mechanism effecting the formation of chromate coatings of proper thickness and color is none too well understood; however, the basis for developing treating formulations may be illustrated in principle by a "bell curve" given in Fig. 1. Certain concentrations of chemical dip constituents attack a metal and corrode it, whereas, others completely prevent the corrosion of the same metal. Over a range between the attacking and inhibiting concentrations, a chromate conversion coating is formed, varying in thickness and quality from poor to optimum to poor. The position of the optimum "plateau" changes from one type of dip to another, and from one metal to another. Occasionally, dissimilar metals can be treated successfully in the same bath under similar conditions

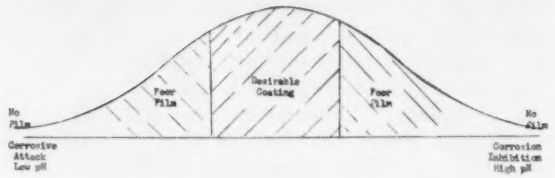

Fig. 1. The Bell Curve.

TABLE 1

Typical Bath Composition for Chromating Zinc and Cadmium

Composition		Immersion Time	Temperature deg. F.	pH	Appearance of Coating
1. CrO_3	30 g./l.	15 to			
H_3PO_4	10 c.c./l.	120 sec.		0.5	
HCl	5 "		50 to 180	to	Opaque dark green
HNO_3	5 "			2.0	
H_2SO_4	5 "				
2. CrO_3	10.1 g./l.	1.0 to	Room to 180	1.8	Dull gray
H_3PO_4	85.4 "	10 min.			
NaF	5.0 "				
3. Acid solution containing:					
Fluoride ion (F)	0.9/12.5 g./l.	1.0 to	Room to 180	1.8	Smooth, clear
Chromic acid (CrO_3)	3.75/60.0 "	10 min.			
Arsenate (AsO_4)	32.4/162 "				
Ratio, F:CrO_3	0.18 to 0.36				
4. Hexavalent Cr	22.2%	½ to	Not	0.8	
SO_4	23.4%	5 min.	Critical	to	Deep black tone
$C_2H_3O_2$	15.0%			2.5	
Silver	0.5%				
5. Chrome alum or		5 to	50 to 130	---	-------
Chromic sulfate	1 oz./gal.	20 sec.			
HNO_3	0.1-0.75% by vol.				
6. Chromic acid, chromate		30 to	60 to 212	0.2	Yellow to black
or dichromate	60-100 g./l.	240 sec.			
$ZnCl_2$	5-15 "	1-60 sec. (plate)			
7. $Na_2Cr_2O_7$	83 g./l.	5 to	60 to 212	---	Yellow through orange
CrO_3	33 "	120 sec.			to green and black
KBr	27 "				
8. Chromic acid or salt	4 to 18%	15 to	Room to 180	---	-------
Tartaric, succinic,		120 sec.			
citric acid or salts	0.5 to 9%				
Mineral acid or salts	0.1 to 8%				

Note:—Percentages are by weight unless otherwise specified.

TABLE 2

***Chromate Conversion Solutions for Zinc and Cadmium*[8]**

No.	Operation	Color	Surfaces Applied	Operating Temp. (F)	Immersion Time	Salt Spray to White Salts on Zinc Plate
TYPE I — Simple dip chemical polishing solutions operating at a pH range of 0.0 or less to 1.5 producing lustrous clear to light iridescent yellow coatings of medium corrosion resistance.						
1	1 dip	Clear to blue tint	Zn and Cd plate	70-100	5-20 up to 20 seconds	24 to 100 hrs.
2	1 dip	Iridescent yellow	Zn & Cd plate; Zn die castings; galvanizing	70-100	5-20 sec.	100 to 200 hrs.
2A	1 dip using acid or alk. bleach dip	Clear to blue tint, iridescent	Zn & Cd plate; Zn die castings; some galv.	70-100	5-20 sec.	24 to 100 hrs.
TYPE II — One dip non-polishing solution operating at a pH of 1.0 to 3.5 producing medium to heavy films ranging in color from iridescent yellow to bronze, olive drab and black generally providing maximum corrosion resistance.						
1	1 dip	Iridescent yellow to bronze	Zn & Cd plate; Zn die castings; galv.	60-90	15-45 sec.	100 to 200 hrs.
2	1 dip	Olive drab	Zn & Cd plate; Zn die castings; galv.	70-90	15-45 sec.	100 to 500 hrs.
3	1 dip	Black	Zn plate	60-90	1 to 5 min.	24 to 100 hrs.
TYPE III — Anodic solutions operating at a pH of 2.5 to 6.0 and 5 to 50 amps/ft^2., ranging in color to yellow and black.						
1	Anodic	Yellow	Zn plate	70-90	3 to 5 min.	100 to 200 hrs.
1A	Anodic, and bleached	Clear to slightly iridescent	Zn plate	70-90	3 to 5 min.	50 to 100 hrs.
2	Anodic	Black	Zn plate	70-90	3 to 5 min.	50 to 100 hrs. (sealed 100 to 200 hrs.)

Note:—Type II films, with the exception of black, can be dyed with certain alizarine and diazo dyes in colors of red, green, blue and black while still wet during processing.

of temperature, pH, etc., but, in most cases, composition and process modifications are necessary.

The combination of hexavalent chromium concentration, activator type and concentration and pH, the chemical balance of the solution, largely determines the type coating that will be obtained, or whether a coating will be obtained at all at a given temperature and immersion time. As the solution is depleted through use, it is replenished by maintenance additions as indicated by control tests. Usually the most critical factor in control is pH. A very effective control method uses pH and hexavalent chromium determination.

Chromate baths, as a rule, cannot be maintained indefinitely but must be dumped periodically and made up fresh. The inoperative point is reached when normal coatings are no longer obtained even though control tests show the solution to be in proper chemical balance, or when excessive additions are required to keep the bath in operation. This inoperative condition is apparently due to the build-up of contaminants such as trivalent chromium from the film forming reaction, dissolved metal from the work being treated, and miscellaneous contaminants dragged into the solution. Expected life of the bath varies with the treatment and depends also on the thoroughness of cleaning, rinsing, and dragout.

Examples of typical chromate conversion baths will be given. Some of the compositions are rather specific while others give a rather wide range of concentrations. The classification of baths by metals is not rigid; a slightly modified bath will frequently yield a good coating on a different metal surface. Due to the diversified activity within this field, along with the continual appearance of new products, the formulations given are far from complete. In addition, since many of the formulations given are proprietory treatments, their inclusion within this article does not constitute a release from patent restrictions in force.

Treatments for Zinc and Cadmium

Within this classification, the products that are given a chromate conversion coating would include electrodeposited metal, zinc-base die-castings and zinc-coated sheet products. A number of formulations are given in Table 1.

On plated work, a typical cycle would include a ½ per cent nitric acid dip after plating and rinsing to serve as a neutralizer and activator; immersion in the chromate solution to obtain the protective film; bleach to obtain a clear or light iridescent effect when desired; either warm or cold water rinse; hot rinse; and, dry. To obtain satisfactory results, the deposit thickness should be between 0.2 and 0.7 mil. In addition, the electrodeposit should be fine-grained and

TABLE 3

Typical Salt Spray Data[11] for Zinc Plated Steel (0.0003" to 0.0007")

	Hours to White Corrosion	Hours to Red Rust
No treatment	<8	150- 400
Clear bright or bluish bright	24-100	250- 750
Yellow to bronze	100-200	250-1000
Electrolytic yellow	100-200	------
Electrolytic, bleached	50-100	------
One-dip black	24-100	------
Olive drab	100-500	500-1500
Electrolytic black	50-100	------
Electrolytic black, Sealed	100-200	------

non-porous. The use of brighteners in the plating bath is acceptable, particularly when a bright chromate coating is desired. However, brighteners containing heavy metals, which may discolor the chromate film, and insoluble oils that form an interfering film over the plate, should be avoided. Immersion periods are critical since re-dissolving of plate may occur during the conversion treatment. When long immersions in the chromating bath are required, bath modifications may be necessary to prevent undue stripping.

Zinc die-castings and zinc-coated sheet products require pretreatment to remove oxide films and oily contaminants. Die-castings are usually degreased, followed by a mild alkaline cleaning, and activation in a 1.0 to 2.0% sulfuric acid solution. Zinc-coated products follow a similar pattern; however, a phosphoric acid butyl cellosolve or a caustic soda cleaning procedure is employed. "Burnt" areas, or zinc coatings that are high in iron, can be given a chromate treatment, but the color will be a dull brown rather than an attractive iridescent yellow.

An interesting comparison of chromate conversion coatings based on pH range along with solution characteristics is given in Table 2. As is indicated in No. 2A, Type I coating, the clear, bright finish, that is obtained by a leaching process, a loss of corrosion resistance may be expected as compared to a coating that has not been leached (No. 2, Type I). Retention of alkali from the bleaching operation will reduce the adhesion of organic finishes and accelerate finger printing.[8] In the application of a bright finish on zinc die castings, premature discoloring of the clear film can be prevented by plating a thin deposit of copper or cadmium on the surface of the casting.

Type II coatings, produced within the pH range of 1.0 to 3.5, have heavier films of a deeper color. They usually are not given a brightening treatment. The anodic type treatments given within Type III coatings are seldom used due to additional equipment requirements. However, it has been stated[8] that the electrolytic baths are easier to control and the resultant deposit has superior abrasion resistance. These coatings may also be bleached; however, as is indicated by No. 1A, type III solution, a reduction in corrosion resistance as measured by salt spray test will be experienced. Typical salt spray data to both white corrosion and red rust for various conversion coatings on zinc plated steel is given in Table 3.

TABLE 4

Typical Bath Composition for Chromating Copper and Brass

Composition		Immersion Time	Temperature, deg. F.	pH	Appearance of Coating
1. CrO_3	8.5 to 175 g./l.	1.0 to	Over 190	----	------
The chromic acid solution is then saturated with ZnO, $ZnCO_3$ or $Zn(OH)_2$. Rinsed with Zn-Cr solution containing 0.075-15 g./l. CrO_3		5.0 min.			
2. Acid solution containing:					
Fluoride ion (F)	0.9 to 12.5 g./l.	1.0 to	Room to 180	1.8	Smooth, clear
Chromic acid (CrO_3)	3.75 to 60 "	10 min.			
Arsenate (AsO_4)	32.4 to 162 "				
Ratio, F:CrO_3	0.18 to 0.36 "				
3. Chromic acid, chromate or dichromate	60-100 g./l.	1-60 sec.	60-212	0.2	Yellow to black
$ZnCl_2$	5-15 "				
4. $Na_2Cr_2O_7$	83 g./l.	5 to	60-212	----	Yellow through orange
CrO_3	33 "	120 sec.			to green and black
KBr	27 "				

Note:—Percentages are by weight unless otherwise specified.

Treatments for Copper and Brass

Typical chromate conversion bath formulations for copper and brass are given in Table 4; these proprietary solutions rapidly are replacing the older bright acid dips, realizing the advantages of:— (a) improved brightness of surface; (b) passivation of metal surfaces; and, (c) elimination of the need for ventilation, since these solutions are non-fuming. These coatings frequently can be colored with organic dyes. An interesting application of chromate bright dipping of copper is as a substitute for mechanical buffing in preparing a surface for subsequent chromium plating.

The corrosion resistance of these films is fair. Pocock[3] indicates that salt spray testing to a green corrosion product will result in a 24 and 50 hour resistance for bright and heavy film copper panels, respectively, as compared to less than 24 hours for untreated panels. Similarly, salt spray tests on brass will result in a 100 and 150 hour resistance for bright and heavy film panels, respectively, as compared to less than 24 hours resistance on untreated panels.

Treatments on Aluminum and Aluminum Alloys

The chromating treatment, of which several formulations are given in Table 5, forms a thin, inert oxide film of about 0.01 mil in thickness on aluminum base alloys. These films have low electrical resistance, good paint adhesion and better corrosion resistance than anodized coatings. Other advantages would include self-healing ability on scuffed areas, and the ability to be formed without flaking. The above properties, along with the relatively lower cost of application, has resulted in acceptance as a substitute treatment for anodizing.

Chromate coatings may be applied to all of the commercial aluminum alloys in either the rolled, drawn, extruded, or cast form; the only variation of film characteristic is that the color may change with the alloy treated. Yellow and brown films can be modified in color by the application of organic dyes. Table 6 gives salt spray data for several typical aluminum alloys, before and after the chromate treatment. As indicated, the protective value increases with film thickness, as evidenced by the darker color for a given treatment.

Cleaning procedures are particularly important prior to chromating if optimum appearance and properties are to be obtained. The initial step would be vapor degreasing to remove heavy oil or grease films, after which the cleaning procedure will vary with the alloy type. Suggested procedures include:

1. Those alloys that contain less than 1.0% silicon would be cleaned in hot alkali, rinsed, deoxidized in 50% aqueous nitric acid containing a wetting agent, rinsed, and chromated.
2. Those alloys that contain more than 1.0% silicon would be etched in an alkaline cleaner, rinsed, dipped in nitric-hydrofluoric acid to remove smut, rinsed, and chromated.
3. A polished surface would be cleaned in a non-etch type alkaline cleaner, rinsed, deoxidized as in (1), rinsed, and chromated.

TABLE 5

Typical Bath Composition for Chromating Aluminum and Its Alloys

Composition		Immersion Time	Temperature deg. F.	pH	Appearance of Coating
1. HF	0.25/11.0 g./l.	1.0 to	Not critical	Less	Yellow to golden brown
$(NH_4)_2Cr_2O_7$	10 to 350 "	5.0 min.		than 3	
2. Na_2CO_3	2.0%	20 min.	150	—	Yellowish green
$K_2Cr_2O_7$	0.1%				
3. Na_2CrO_4	5 to 6 g./l.	15 min.	200 to boil	—	Purple to green-gray
NaClO	5 "				
Na_2CO_3	20 "				
4. Acid solution containing:					
Fluoride ion (F)	2 to 6 g./l.	1.0 to	Room to 180	1.8	Smooth gray to pale
Chromic acid (CrO_3)	6 to 20 "	10 min.			green.
Phosphate ion (PO_4)	20 to 100 "				
Ratio, F:CrO_3	0.18 to 0.36				
5. Acid solution containing:					
Fluoride ion (F)	18 to 20 g./l.	—	40 to 100	3.6	Clear
Dichromate ion (Cr_2O_7)	12 to 18 "			to	
Phosphate ion (PO_4)	50 to 55 "			4.0	
6. Na_2CO_3	5 to 10%		180 to 212	—	------
NaOH	0.1 to 0.4%	5.0 to			
$K_2Cr_2O_7$	0.2 to 2.0%	20 min.			
$AlCl_3$	0.1 to 0.3%				

Note: Percentages are by weight unless otherwise specified.

TABLE 6

Typical Salt Spray Data for Aluminum[3]

	Hours to White Corrosion Product		
	No Treatment	*Clear Coating*	*Yellow or Brown Coating*
Alloy 3003 (Commercially pure aluminum)	24	60-120	250-800
Alloy 2024-T (Copper-magnesium-aluminum type)	<24	40- 80	150-600
Alloy 13 (die casting composition)	< 8	12- 40	50-250

Treatments for Magnesium Base Alloys

A variety of bath compositions may be employed, a number of which is given in Table 7. The treatments under consideration will be Dow No. 1 chrome pickle, No. 7 dichromate and No. 10 sealed chrome pickle. All of these solutions produce coatings that serve as a base for painted finishes. Their colors range from light to dark yellow-red-browns; the variation of color being due to both the alloy type and heat treatment as well as the age and strength of the treating solution. A uniform color may not always be evident; however, non-uniformity in color does not always mean non-uniform corrosion resistance.

No. 1 chrome pickle, which is frequently termed a suppliers' treatment, is commonly used as a protective coating during shipment and storage of sand and permanent mold castings as well as wrought products that are subsequently hot formed. The coating may be applied either by dipping or brushing, and may be used where the magnesium assembly has either steel or brass inserts. Polished steel surfaces, however, should be protected with a thin film of stop-off lacquer which may be removed later with a solvent.

Two solutions may be used. Type 1, given in Table 7, is for wrought products, whereas, type 2 is designed for cast products. A definite etching action takes place

TABLE 7

Typical Bath Composition for Chromating Magnesium Alloys

Type	*Composition*		*Immersion Time*	*Temperature deg. F.*	*pH*	*Appearance of Coating*
1.	$Na_2Cr_2O_7$	24 oz./gal.	0.5 to	70-90	----	Matte gray to yellow-red iridescent
	Conc. HNO_3	24 "	2.0 min.			
	Comments: Wrought alloys 5 sec. air exposure after dipping.					
2.	$Na_2Cr_2O_7$	24 oz./gal.	0.5 to	70-90	----	Matte gray to yellow-red iridescent
	Conc. HNO_3	16-24 "	2.0 min.			
	Na, K or NH_4 acid fluoride	2 "				
	Comments: Cast alloys 5 sec. air exposure after dipping.					
3.	$Na_2Cr_2O_7$	16-24 oz./gal.	30 min.	Boiling	4.1	Light to dark brown
	CaF_2 or MgF_2	½ "		200 min.	min.	
4.	Dual Treatment—#1 or #2 (chrome pickle) followed by water rinsing, followed by #3 (dichromate boil)					
5.	$K_2Cr_2O_7$	15%	20 to	-------	----	-------
	HNO_3	7.5%	60 sec.			
6.	Two Baths					
	#1 HF or	15-20%	5 min.	70-90	----	-------
	NaF	5%	15 min.	70-90	----	-------
	#2 $Na_2Cr_2O_7$	10-15%	45 min.	Boiling	----	Brown to black
7.	$Na_2Cr_2O_7$	100 g./l.	10 to	Room to	3-6	Black
	$MnSO_4 \cdot 4H_2O$	30-70 "	120 min.	Boiling		
	$MnSO_4 \cdot 7H_2O$	30-70 "				
8.	Acid solution containing:					
	Fluoride ion (F)	0.9-12.5 g./l.	1 to	Room to	1.8	Smooth, clear
	Chromic acid (CrO_3)	3.75-60 "	10 min.	180		
	Arsenate (AsO_4)	32.4-162 "				
	Ratio F:CrO_3	0.18-0.36 "				

Note: Percentages are by weight unless otherwise specified.

during the immersion treatment, usually to the extent of 0.0006" per surface and, therefore, it is not recommended for application on machined surfaces unless tolerance will permit or proper allowances have been made. The most desirable paint base is a mat gray to yellow-red iridescent coating which exhibits a network or pebbled etch under the microscope. This type of coating is readily obtained in fresh solutions. Bright, brassy coatings having a relatively smooth surface, which may appear in the treatment of M and ZK60A alloy, are usually associated with inferior paint adhesion. In the treatment of these alloys, it may be necessary to use either a fresh solution or one that has been revivified no more than once.

A suggested flow chart for the treatment of wrought products (Type 1, Table 7) would consist[11] of:—hot alkaline cleaning for 3 to 10 minutes, cold water rinsing, chrome-pickle treatment, cold water and hot water rinsing. The treatment for cast products is similar, with the exception that a hot rinse is required prior to immersion in the chromating solution to pre-heat the casting. Failure to include this operation may result in practically no coating during a 10 second immersion.

Care must be taken that a gray, non-adherent, powdery coating does not form, since it is a potential fire hazard. This type of coating may be minimized on castings by the use of the fluoride modified chrome pickle (Type 2, Table 7). However, excessive treatment time in this bath may also result in this type of coating. A brown non-adherent powdery coating may also be encountered; suggested causes[11] for its formation include:—(a) the part was exposed in air too long subsequent to chromating; this interval being about 5 seconds before rinsing; (b) the ratio of acid concentration to sodium dichromate content may be too high; (c) the chromating solution may be too hot; the suggested range being 70 to 90°F.; (d) degreasing may have been inefficient; and, (e) the solution may have been revivified too many times.

The dichromate treatment (type 3, Table 7) provides excellent corrosion resistance and good paint characteristics to all magnesium alloys with the exception of alloy M. Properly applied coatings vary in color from light to dark brown depending upon the alloy. Since no appreciable change in dimensions occur during chromating, this treatment may be applied to finished machine parts.

A recommended[11] flow chart would include:— (a) vapor degreasing for the removal of heavy soil; (b) hot alkaline cleaning, from 3 to 10 minutes; (c) cold water rinse; (d) hydrofluoric acid pickling and activation of surface; (e) cold water rinse; (f) boiling dichromate bath immersion for 30 minutes; and, (g) cold and hot water rinses. Castings and other parts containing bearings, studs and inserts of brass, bronze, cadmium plate, and steel may be processed as above. However, aluminum inserts will be rapidly attacked by the hydrofluoric acid dip, necessitating the substitution of a acid fluoride pickle when required.

Abnormally heavy coatings should be avoided when used as a base for adhesive bonding, although it may be satisfactory both as a paint base and for corrosion resistance. This may be caused by both a low pH (4.1 min.) or electrical contact between the work and the tank. Loose, powdery coatings are also objectionable, and may be traced to a number of reasons which would include:— (a) low hydrofluoric acid or acid fluoride content; (b) low pH in the dichromate bath; (c) contamination of work surfaces that have not been properly removed during the process cycle; and, (d) electrical contact between the work and the tank in the dichromate tank.

The sealed chrome pickle (type 4, Table 7) is essentially a combination of the chrome pickle and dichromate boil treatment. The resultant surface has a varying mat gray to a yellow-red iridescence of the chrome pickle plus the brown of the dichromate. As with the chrome pickle treatment, the metal removal experienced by this process is sufficient to exclude the processing of machine parts.

The operational steps would be similar to that given for the chrome pickle treatment with the exception that the parts are submitted to a standard chrome pickle treatment and a dichromate boil with a water rinse spaced between the two operations. This treatment is commonly used for wrought products; however, it may be also applied to castings.

Treatment for Silver

At least one proprietary chromate treatment is now available for silver, which produces[4] a very thin colorless or slightly tinted film on plated or solid silver. This film provides a high degree of resistance to sulfide tarnishing and salt spray corrosion and causes very slight decrease in surface electrical conductivity.

Chromate vs. Phosphate Coatings

It may be well to point out the essential differences between the chromate and phosphate conversion coating to determine basic characteristics. Thus:—

1. Phosphate coatings are normally used as a base for organic finishing, whereas chromate coatings may be used both as a final coat and a pretreatment for paint.

2. The corrosion protection given by both is similar. A zinc part phosphated and painted exhibited a 1/32 inch corrosion creepage after 300 hours salt spray. A heavy chromate film without subsequent organic finishing will exhibit from 200 to 300 hours resistance in salt spray. Tests at 100% humidity at 100°F. will show pinpoint blistering in both coating types after 1000 hours.

3. Chromate coatings are selfhealing, whereas, phosphate coatings do not have this characteristic.

4. Phosphate coatings are very hard, whereas, chromates are soft, particularly under high humidity conditions.

5. Chromate coatings can be dyed for color coding or indoor exposure, whereas, phosphate coatings cannot be colored successfully.

6. Phosphate coatings are applied to both ferrous and non-ferrous metals and frequently can be intermixed during processing. Chromate processing may be used on non-ferrous and steel parts that have been plated, and are usually one metal type solution.

FINISHING POINTERS

Specific Gravity Equations

By J. B. Mohler
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THE metal content of chromic acid baths and copper sulfate baths is controlled by the use of a hydrometer. Nickel and the metal in other acid baths can be determined by this means, also sodium carbonate in alkaline and cyanide baths.

An equation of the following form will express the relationship between specific gravity and concentration:

$$\text{Sp. Gr.} = A_1C_1 + A_2C_2 + A_3C_3 \text{ ———}$$

where: A = the concentration of a chemical substance

C = a specific gravity constant

The equation was tested with existing data[1] reproduced in part in Table 1.

The specific gravity constants of Table 2 were calculated from specific gravity data on single chemicals.[2] Those constants marked with an asterisk were assumed as a first approximation.

Agreement of the experimental and calculated values is good considering the number of constants, a first approximation, and data from various sources. Experience with this equation has shown that agreement is much better when a number of solutions, consisting of variations of a single bath, are prepared to establish specific constants. The constant will vary with temperature but a temperature correction can be applied

TABLE 1
Specific Gravity of Plating Baths

Bath	*Chemicals*	*g./l.*	*°Be 25°C.*	*Specific Gravity — 25°C. experimental*	*calc.*
Brass	CuCN	30	10.9	1.082	1.086
	$Zn(CN)_2$	10			
	NaCN	56			
	Na_2CO_3	30			
Cadmium	CdO	30	11.3	1.085	1.084
	NaCN	110			
Copper Sulfate	$CuSO_4 \cdot 5H_2O$	200	20.6	1.166	1.172
	H_2SO_4	75			
Rochelle Copper	CuCN	26	11.0	1.083	1.094
	NaCN	35			
	$NaKC_4H_4O_6$	45			
	Na_2CO_3	30			
Copper Cyanide	CuCN	120	22.0	1.179	1.179
	NaCN	130			
	NaOH	30			
Copper Cyanide	CuCN	56	13.9	1.106	1.120
	KCN	85			
	KOH	41			
Watts Nickel	$NiSO_4 \cdot 6H_2O$	240	21.7	1.176	1.179
	$NiCl_2 \cdot 6H_2O$	45			
	H_3BO_3	30			
	H_2SO_4	0.23			
Silver Cyanide	AgCN	40	12.7	1.095	1.112
	KCN	60			
	K_2CO_3	60			
Zinc Cyanide	$Zn(CN)_2$	60	12.0	1.090	1.104
	NaCN	23			
	NaOH	53			
Zinc Sulfate	$ZnSO_4 \cdot 7H_2O$	240	19.5	1.155	1.151
	NH_4Cl	15			
	$Al_2(SO_4)_3 \cdot 18H_2O$	30			
Alkaline Cleaner	Na_2CO_3	30	5.8	1.042	1.043
	$Na_3PO_4 \cdot 12H_2O$	15			
	NaOH	8			

TABLE 2
Specific Gravity Constants

Chemicals	*Constant*
$ZnSO_4 \cdot 7H_2O$	0.000545
NH_4Cl	0.000309
$Al_2SO_4 \cdot 18H_2O$	0.000510
$CuSO_4 \cdot 5H_2O$	0.000622
H_2SO_4	0.000635
Na_2CO_3	0.000972
NaOH	0.001054
Na_2SO_4	0.000868
KOH	0.000876
K_2CO_3	0.000860
$NiSO_4 \cdot 6H_2O$	0.000577
$NiCl_2 \cdot 6H_2O$	0.000505
$Na_3PO_4 \cdot 12H_2O$	0.00037*
H_3BO_3	0.00060*
AgCN	0.00057*
CuCN	0.00057*
$ZnCN_2$	0.00057*
CdO	0.00057*
NaCN	0.00061*
KCN	0.00061*

*first approximation

to the equation. The constants are reliable over a fairly wide range of concentrations. However, if maximum accuracy is desired, they should be determined for the selected range to be controlled.

Notice that agreement is very good with the Watts nickel bath. This is due to reliable gravity data on nickel sulfate which is present as the predominant chemical. The equation of this bath is:

Sp. Gr. $= NiSO_4 \cdot 6H_2O \times 0.000577 + NiCl_2 \cdot 6H_2O \times 0.000505 + H_3BO_3 \times 0.00060$

The specific gravity equation should be used as a rapid means of determination of the total chemical concentration of a bath. One of the major chemicals can then be calculated from the specific gravity if all other chemicals are determined by other means.

Every plating bath has a maximum and a minimum total chemical concentration. These total limits can be expressed as specific gravity, which then provides a quick check on whether or not the bath is within these total limits.

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Nonflammable Painting Processes Reduce Costs

By F. G. Schumacher, *Chlorine Products Division, Electrochemicals Department, E. I. du Pont de Nemours & Company, Wilmington, 98, Del.*

Summary

This article describes both dip and spray-in-vapor application methods for new, trichlorethylene-thinned paints. A method for integration of trichlorethylene-thinned painting with a prior vapor degreasing step is also described. Use of the new painting methods offers important savings in investment, space, time, paint and thinner, operating labor, and utilities costs; it also eliminates the need for extensive fire protection equipment since trichlorethylene is rated by the Underwriters' Laboratories as nonflammable at ordinary temperatures. A forecast of future progress in the field of trichlorethylene-based finishing is also provided.

Introduction

THE industrial finishing industry has a choice of a wide variety of methods which may be used to apply paints to metal parts. It is not the intent of this article to compare in detail the choices which are available, but instead to describe new finishing methods, which employ paints thinned only with nonflammable* trichlorethylene, and to show advantages obtainable through their adoption. This can best be done by comparing older finishing techniques with those which are now available through use of trichlorethylene-thinned paints.

Most widely-used finishing procedures require a series of steps which are difficult to defend from the standpoint of logic or economics but which gained wide acceptance because no good alternate methods existed. For example, the finishing sequence for a simple one-coat priming system might include:

1. Washing of work in hot alkali-detergent solution.
2. Rinsing in hot water to remove cleaning compounds.
3. Drying in oven — to remove water.
4. Cooling.
5. Applying paint by dipping or flow-coating — extensive fire protection equipment needed.
6. Draining of excess paint — a fire and housekeeping hazard.
7. Drying or baking of paint film — no recovery of thinner.
8. Cooling the work prior to shipment.

Key areas for improvement in the above sequence are: reduction in processing steps, thus saving operating and investment cost; elimination of wetting work with water, followed by heating to remove water; virtual elimination of flammability hazards; better utilization of heat input; and recovery of thinner.

Adoption of a finishing system which utilizes a common medium, trichlorethylene, for both the cleaning and painting steps, permits industrial finishers to realize important savings through an improved finishing sequence:

1. Vapor degreasing to remove soil.
2. Applying hot trichlorethylene-thinned paints at once to the hot parts by dipping or spraying, using techniques to be described, permits recovery of thinner.
3. *Where necessary,* baking the finish.
4. Cooling the work prior to shipment.

The above process contains at most only four steps. However, in many cases, Step 3 can be eliminated, as work removed from the paint application step is dry and free of thinner. Hence, baking is not necessary where air-dried finishes are employed, or where a second coat is to be applied by hand spray or electrostatic spray, and a single baking operation (monobake) will be acceptable. Thus, by comparison with the first-described process, we have:

1. Eliminated—flammability hazards.
2. Avoided—wetting and drying of the work prior to painting.
3. Eliminated—one heating and cooling cycle.
4. Created—an opportunity to save space, time, equipment, labor, and materials costs.

The improved finishing technique is based upon either dip application or spray-in-vapor application of new trichlorethylene-thinned paints. As there are significant difference in these techniques, they will be discussed in detail in subsequent sections of this article. Detailed savings estimates are also included.

Dip Application of Trichlorethylene-Thinned Paints

Initial industrial promotion of hot-dip trichlor-

*Trichlorethylene is rated by the Underwriters' Laboratories as nonflammable at ordinary temperatures. Complete detail is given in U. L. File MH-494; see also MCA Bulletin SD-114, "Trichlorethylene."

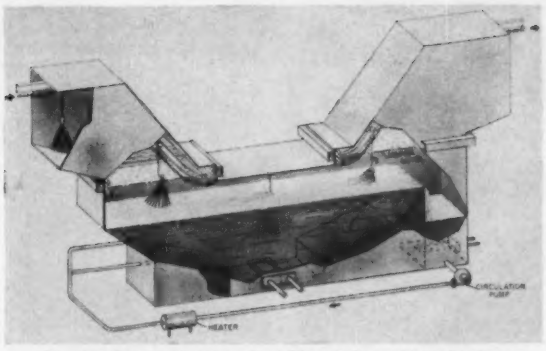


Fig. 1. Dip application of trichlorethylene-thinned paint.

ethylene-thinned paints was undertaken by the Harding Chemical Company of Detroit, Michigan, based upon a series of patents which were filed shortly after World War II.[1,2] As is often the case, industrial acceptance of the new method was slow. In promoting the development, it was necessary not only to design new equipment, but also to develop sources of paints which could be used in the new process. Today, there are about a dozen hot-dip trichlorethylene-thinned painting units in operation, and several more are being designed.

A typical hot-dip unit designed for application of trichlorethylene-thinned paints is shown in Figure 1. Operation of the unit is both simple and rapid.

A typical hot-dip unit operates as follows:

(1) Clean work enters at the left from the discharge of a vapor degreaser, or from a drying oven if wet cleaning methods are used.

(2) The work is dipped into a tank containing hot trichlorethylene-thinned paint, which is kept at constant level by overflowing continuously into a reservoir.

(3) Paint from the reservoir is pumped continuously through a heat exchanger back to the main paint tank. This maintains constant paint temperature and composition.

(4) As the part emerges from the paint, the trichlorethylene thinner, a pure chemical compound which has a low boiling point, "flashes" from the paint film within a few seconds. As the solvent vapor is nearly five times heavier than air, it sinks back into the machine, and condenses on the coiling coils. The condensate, virtually pure trichlorethylene, is recovered for use either in a vapor degreaser, or for thinning of fresh paint charges.

In many instances, there is little to choose between dip application or spray-in-vapor application of trichlorethylene-thinned paints. However, each method has its unique advantages, and there are factors which definitely favor one process over the other. Factors favoring dip application are:

1. *Concealed or Hidden Surfaces*: Some parts, such as the interior of hollow tubular sections, can be painted only by dipping. No other method provides adequate coverage for such hard-to-reach surfaces.

2. *Painting of Small Parts*: Where myriad small parts are to be painted, it is often most efficient to hang these on racks or cross-rods and then dip the work into trichlorethylene-thinned paints. Where color changes are indicated, it is often feasible to change the entire tank, rather than spend the effort needed to clean out a tank and recharge it.

3. *Operating Temperature:* A dip painting unit operates most efficiently at temperatures closely approaching the boiling point of the paint (188°-195°F.). However, where careful attention is paid to equipment design, it is often possible to operate economically at temperatures as low as 140°-150°F. Operating at the lower temperatures makes it possible for the paint supplier to employ resins which might prove thermally unstable at higher temperatures.

4. *Simplicity:* A dip tank contains a large volume of paint in relation to the amount which is used daily. Once proper adjustment of temperature, viscosity, solids content, etc., is secured, the tank will remain in service for long periods with little or no attention. Since the required control instruments are simple, initial equipment investment may prove to be low. Thus the process is attractive to smaller operators.

5. *Work Quality:* Where necessary to minimize runs or wedging, operation of a conveyorized dip system often proves an excellent choice. As the paint "sets" with extreme speed upon withdrawal from the paint charge, opportunity for creation of unsightly runs is virtually eliminated.

Spray-in-Vapor Application of Trichlorethylene-Thinned Paints

Spray-in-vapor application of trichlorethylene-thinned paints, a newly-developed process[3] which has come from the Du Pont laboratories, has attracted wide attention in the finishing industry. As will be seen, the spray painting development opens the way for realizing maximum flexibility and savings in both initial equipment investment and operating cost.

Spray-in-vapor application of trichlorethylene-thinned paint is shown in Figure 2. Essential operating principles are given below:

1. Clean work enters at the left from the discharge of a vapor degreaser, or from a drying oven if wet cleaning methods are used.

2. Work passes into an atmosphere of pure, air-free trichlorethylene vapor, and then to a spray zone where hot trichlorethylene-thinned paint is sprayed onto the workpiece. Thus, the process is aptly described as a "spray-in-vapor" process.

3. The painted part passes for a short time period through trichlorethylene vapor, where excess paint drips from the work and is recovered.

4. As the wet work leaves the vapor zone, the tri-

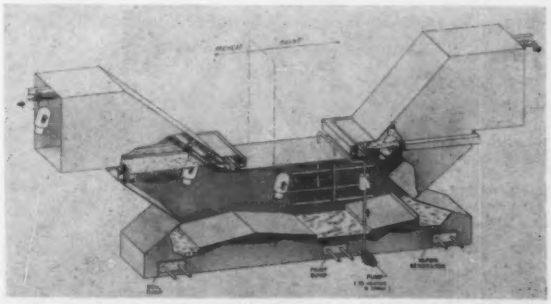


Fig. 2. Spray-in-vapor application of trichlorethylene-thinned paint.

chlorethylene thinner evaporates almost instantaneously and is removed.

As was indicated earlier, it is often difficult to choose between dip application and spray-in-vapor application of trichlorethylene-thinned paints. However, for the guidance of those who are interested in trichlorethylene-thinned painting, factors favoring spray application are given:

1. *Trapped Sections*: Work which contains traps, which could cause work to float from hooks, or which could form air pockets, must be painted by spray techniques.

2. *Paint Inventory:* A spray-in-vapor unit can often operate on a paint charge which is small enough to be "turned over" in a few days' time. This not only permits manufacturers to formulate products for a short "pot life," but also allows the process user to paint large work with a minimum paint inventory. A low paint inventory also facilitates emptying of the unit for maintenance purposes.

3. *Color Changes:* Where large work is to be painted, and it is desired to change colors from time to time, the small working paint inventory will permit the user to change colors with minimum effort.

4. *Operating Economy:* Use of the "spray-in-vapor" principle permits *integration* of the cleaning and painting steps in a single equipment piece, thus providing optimum economy and minimum initial investment. Through integration of these two steps, it is possible to reduce both floor space and installed equipment costs by 30%-40% as compared with the cost of installing two separate, but connected units for vapor degreasing and paint application. In addition, it is also possible to reduce solvent consumption by 15%-20% by utilizing a single, large, integrated unit, as compared to operating two individual pieces of equipment. A comprehensive description of principles underlying integration of cleaning and painting steps follows:

Integration of Vapor Degreasing with Spray-in-Vapor Application of Trichlorethylene-Thinned Paints

The preceding text has stressed the benefits available through integration of processing steps. Figure 3 shows schematically equipment[3] which is designed to take full advantage of the unique properties offered by trichlorethylene-thinned paints. Both vapor degreasing and spray-in-vapor paint application require the existence of an air-free trichlorethylene vapor zone if operation at peak economy is to be obtained. Therefore, the degreasing and painting units can be integrated to form a *single* piece of equipment. The description of operating principles is condensed from the booklet, " 'Triclene' Trichlorethylene Painting."[4]

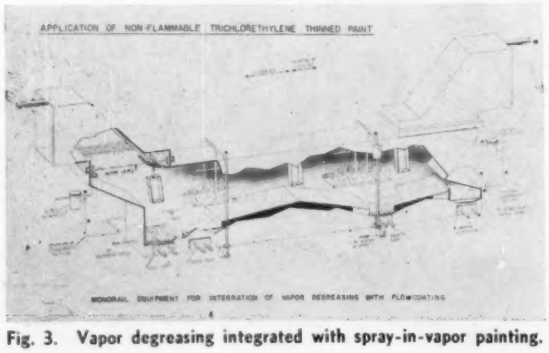
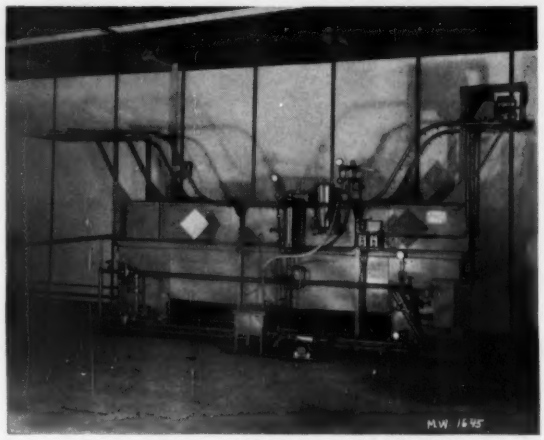


Fig. 3. Vapor degreasing integrated with spray-in-vapor painting.



(Courtesy G. S. Blakeslee & Co., Chicago)

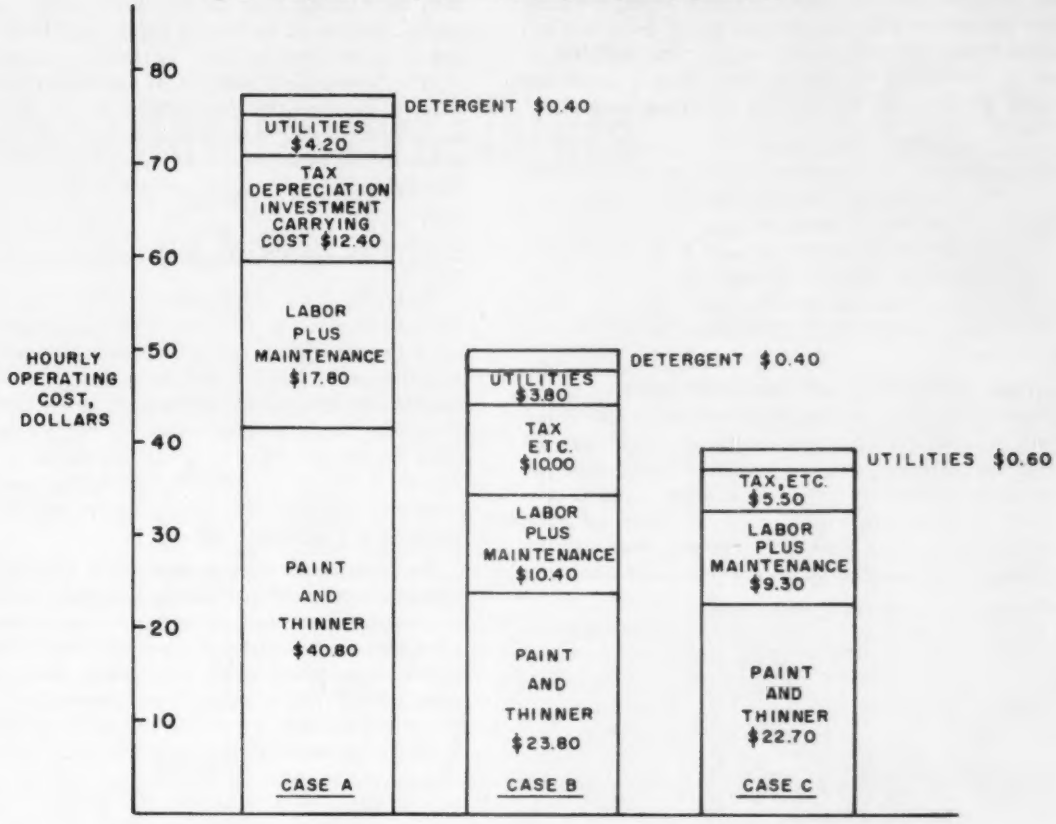
Fig. 4. Demonstration unit — spray-in-vapor application of trichlorethylene-thinned paint.

The unit consists essentially of two sections. The first section serves to clean the incoming oily or greasy parts by use of standard degreasing techniques. The parts leave this section at the proper temperature for spray painting, which is substantially that of boiling trichlorethylene. In the second section, the article is coated with paint, which is sprayed at its boiling temperature. Since *an air-free trichlorethylene vapor zone is maintained* THROUGHOUT *the machine at all times,* the surface of the sump remains free of a "skin" of dried paint, and *oversprayed paint is recovered for reuse.* In some applications, it may be desirable to pressurize the paint, and to spray it at temperatures higher than its normal atmospheric boiling point. In the second section, time is also provided for the paint droplets on the part to level and produce a smooth, uniform coating. Run-off of surplus paint to the sump also takes place here. Evaporation or "flashing off" of the remaining trichlorethylene thinner in the paint coat occurs at the instant the part is raised out of the vapor.

As in the dip process, when using an air-drying paint, the part leaves the machine clean, painted, dry to the touch, and ready for immediate packaging or further processing. When baking primers are used, the painted part will often be tacky, but will be free of trichlorethylene thinner. In many instances, it will be possible to apply a finish coat over the unbaked primer coat by conventional spray methods and cure both the prime coat and finish coat in a single baking step.

In developing equipment for the "spray-in-vapor" process, one prominent manufacturer has recently built several operating units of different sizes to evaluate the practicability of the new process before accepting orders for commercial units. The unit shown in Figure 4 was built for demonstration of the process to firms interested in painting their parts on a conveyorized basis. Work up to 12" x 12" x 15" can be hung on the monorail and will pass through the entire cycle without further attention. By changing the de-

Fig. 5. Comparative hourly costs for cleaning and painting operations.



	Case A	Case B	Case C
Total Hourly Finishing Cost	$ 75.60	$ 48.50	$ 38.10
Total Investment	$215,000	$170,000	$94,000
Total Operating Area Sq.Ft.	1,350	1,650	480

Work Load: 480 steel shelves hourly, each 15" x 42", handled on monorail conveyor.

Case A - Includes alkali washing, oven drying, hand-spray with conventional paint, plus drying oven.

Case B - Includes alkali washing, oven drying, dip application of conventional paint, plus drying oven.

Case C - Includes vapor degreasing plus spray-in-vapor application of one coat of air-drying trichlorethylene-thinned paint, using a single integrated operating unit.

sign of the machine, dip painting is also possible. Where dipping is planned, use of a cross-rod conveyor will frequently prove advisable.

Savings Possible Through Use of Integrated Trichlorethylene-Based Finishing

The use of trichlorethylene-based paints permits savings in both initial investment and operating cost. The savings obtainable will, of course, depend largely upon the degree of integration which is possible. Figure 5 compares the cost picture for a fully-integrated degreasing plus spray-in-vapor painting unit when built as indicated in Figure 3 with both a *conventional* hand-spray system and a *conventional* dip system. In calculating the comparisons, alkali washing followed by dryoff ovens was assumed as a cleaning method prior to applying conventional paints.

The data in the table above (Figure 5) are a condensation from an extensive cost study which we have made.[4]

Space does not permit making detailed comments; the following high-spot analysis is given to amplify the information in the chart.

Detergent Cost: The washing unit required addition of detergents to secure its cleaning effect. The cost of trichlorethylene used in degreasing is allowed for under "Paint and Thinner Cost."

Paint and Thinner Cost: This was based for the hand spray case on coverage of 350 sq. ft./gal., and for conventional dip painting at 600 sq. ft./gal. Since drip losses and overspray are recoverable in the trichlorethylene-based painting system, paint coverage

of 700 sq. ft./gal. is possible, when applying the same film thickness. The thinner recovered from the trichlorethylene-thinned paint is more than sufficient to supply the needs of the machine, thus a small net credit results from the efficient operating method.

Utilities Costs: Costs for Case C are lower due to elimination of drying ovens following wet cleaning and ovens for drying the paint film. This savings also applies for many two-coat baking systems, since it will probably not be necessary to bake the prime paint coat in the trichlorethylene-based system, as described earlier. Important savings in steam costs also result when vapor degreasing is substituted for wet cleaning methods.

Tax, Depreciation, and Investment Carrying Costs: These items reflect savings in equipment requirements, and reduced building area needs. In calculating investment carrying costs, a return on investment in operating facilities of 20% was assumed, prior to payments of income taxes (50% rate). As many industrial firms require more than 10% net return on new investment, the calculation is considered conservative.

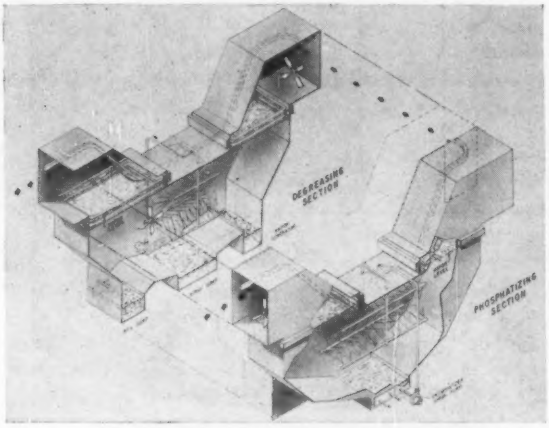


Fig. 6. Schematic diagram of equipment for new degreasing/phosphating process.

Labor and Maintenance Costs: These costs are high for Grade A due to employment of two hand spray operators not needed in Cases B or C. Costs in Case B are higher than in Case C. The difference reflects maintenance costs for the drying ovens.

Availability of Trichlorethylene-Thinned Paints

A few years ago, the only materials available for this process were simple asphaltic paints. However, the incentive of paint suppliers to furnish better-grade paints has increased with increasing acceptance of the process by industry. Several different firms now supply or are accepting orders for both air-drying and baking alkyds in a wide variety of colors, and will also formulate paints from epoxy ester, acrylic, or specialty resins, which dissolve easily in trichlorethylene to form stable solutions.[5]

One important comment concerning process safety should be stressed strongly — trichlorethylene must be used as the sole thinner in the paints formulated for use in the processes described herein. Trichlorethylene must also be used as the sole solvent in resins used for making these paints. Where resins are purchased, they must be bought either as "100% solids" materials, or must be "cut" in trichlorethylene rather than in flammable thinners. This precaution is strongly advised, because the composition of the paints can easily shift during use. Thus, an initially non-flammable paint containing relatively small amounts of flammable thinner might become flammable during use.

Latest Finishing Developments

Many finishing plants now require that all steel surfaces be given a phosphate-type conversion coating prior to painting, in order to achieve optimum paint adhesion and corrosion resistance. The preceding discussion has stressed the advantages of combining the degreasing and painting stages to the greatest possible degree, in order to obtain maximum economy. The need for a water based phosphating unit would obviously interfere with combining the anhydrous degreasing and painting stages.

Du Pont has recently announced[6] a solution to this problem — a trichlorethylene-based phosphating process, which will apply a strongly-adherent form of iron phosphate to steel surfaces, *from trichlorethylene solution.* The solution, which is operated at the boiling point (188°F.) of trichlorethylene, reacts rapidly with the metal surface, to produce a coating weight of from 40 mg./sq.ft. to over 200 mg./sq.ft. in ½ min. to 3 min. time. Preliminary trials have shown that the process can easily be adapted to apply conversion coatings to other active metals such as aluminum or zinc, including galvanized surfaces. Control of the process is both simple and rapid; technically-trained operators are not required. Equipment required for the new process is shown schematically in Figure 6.

The new process, which can readily be included between a conventional vapor degreaser and either a dip or Spray-in-Vapor painting unit, was announced at the 1959 Metals Show at Chicago. At present, two commercial units are in operation as a part of an expanding series of field trials; full commercial use of the process is not planned until mid-1960. Thus, in the coming year, the finishing industry will have available what it has long needed and sought — a practical, rapid, and inexpensive commercial method for complete finishing — cleaning, phosphating, and painting — without wetting the metal surface and without requiring the use of a nonrecoverable flammable thinner.

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Science for Electroplaters

54. The Rochelle Salt Bath

By L. Serota

DIBASIC organic acids such as tartaric, lactic, citric, oxalic, malic, and succinic acids, form complexes with copper. Of this group, the salt of tartaric acid, sodium potassium tartrate $NaKC_4H_4O_6 \cdot 4H_2O$ (Rochelle salt), has found widest use as the Rochelle salt-cyanide copper solution in plating baths.

Whereas, sodium cuprocyanide solutions give satisfactory copper deposits when used at the proper low current densities, appreciable variations in current efficiency will result at the anode and, under the most adverse conditions, the current efficiency will fall almost to zero. This factor, coupled with the increasing demand for heavier metal deposits at faster plating rate, and with throwing power superior to that of the acid copper bath, led to the use of a bath introduced by L. C. Pan, containing a high concentration of copper cyanide and a low free cyanide concentration. This type of bath permitted operation at high current densities and high temperatures, and gave a higher efficiency.

The limited thickness of the metal deposits obtained from this bath was due to the fact that Pan's work was performed at room temperature. This bath is considered, however, the forerunner of present high-speed, high efficiency, copper cyanide baths. The advantages indicated by this development were offset by the increased polarization or passivity experienced at the anode. To aid anode corrosion, J. F. K. McCullough and B. W. Gilchrist recommended the use of Rochelle salt in the copper cyanide bath.

G. J. Bakhvalov, in a study which included the use of varying concentrations of Rochelle salt, sodium carbonate, and sodium hydroxide, found that the tartrate exhibits virtually no influence upon cathode polarization but does act as a depassivator for the copper anode, so that operation at higher current densities is possible without pronounced passivity of the anode or oxidation of the cyanide ion. A decrease in cathode current efficiency results with increase in concentration of Rochelle salt.

The following bath composition is recommended by Bakhvalov: CuCN, 40 g./l.; free NaCN, 6 g./l.; $NaKC_4H_4O_6 \cdot 4H_2O$, 60 g./l.; Na_2CO_3, 30 g./l.; NaOH, 0.1-0.3 g./l. Good deposits are obtained at current density of 2.0-2.5 amp./dm.^{2} Strong anode passivity and oxidation of cyanide ions, it was found, are avoided with an anode current density of 1.0-1.5 amp./dm.^{2}.

In a comprehensive study of the Rochelle salt copper plating bath, reported in METAL FINISHING, A. K. Graham and H. J. Read included in their investigation various factors such as pH characteristics of the bath and of the constituents (caustic soda, carbonates, free cyanide, and tartrate); current density, and pH effect on anode behavior in relation to their effect on this bath.

pH Effect

Sodium bicarbonate, sodium carbonate, sodium hydroxide, and Rochelle salts were added to pure water in concentrations ranging from 0 to 4 oz./gal. The pH of each solution of the different constituents was determined for the various concentrations, at room temperature, by the colorimetric method. Results are shown in Fig. 212.

The graph reveals, for example, that the addition of sodium bicarbonate with a fairly constant pH range in the region of 8.5 will have little effect on pH; sodium carbonate above 0.5 oz./gal. will also give a fairly constant pH (11.5-12.0) and, accordingly, will also exhibit little influence on pH; sodium hydroxide, however, shows a pronounced rise in pH, as the concentration increases, with a buffered effect of the solution occurring at high concentration (alkalinity); sodium cyanide, it will be observed, closely paral-

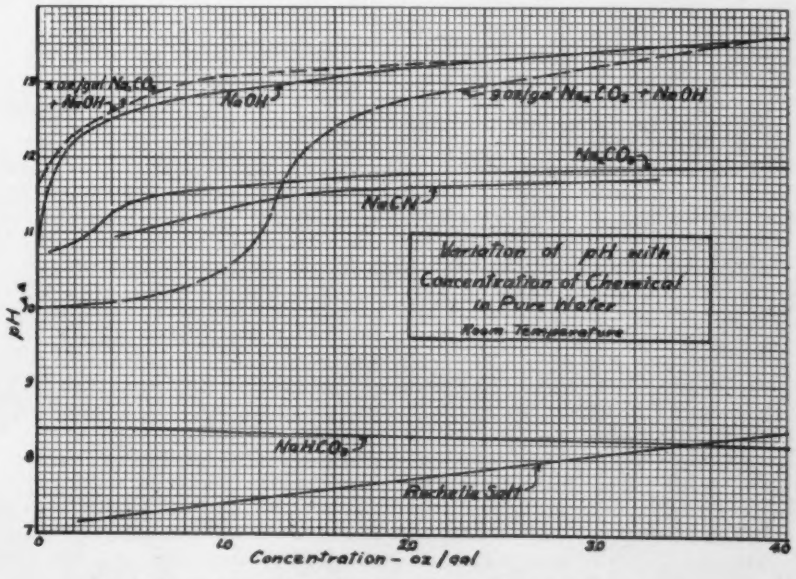

Fig. 212. Variation of pH with concentration of chemical in pure water.

TABLE I. Effect of Variation in Cyanide Copper Bath Constituents[a] on the pH

Copper cyanide oz./gal.	Free cyanide oz./gal.	Soda ash oz./gal.	Rochelle salt oz./gal.	Sodium hydroxide oz./gal.	pH variation
3.5	(0-2.0)	2.0	4.0	.....	10.2-10.3
3.5	0.75	2.0	(0-2.0)	.....	10-0-10.2
3.5	0.75	(0-2)	4.0	.....	10.0-10.0
		(0-15)			10.4-10.7
3.5	0.75	2.0	4.0	(0-0.2)	10.0-10.4
				(0-0.4)	10.4-12.6
				(0-0.6)	10.4-12.8

[a] Variable in (—).

lels the effect produced by sodium carbonate; and, finally, addition of Rochelle salt indicates a steady increase in pH from 7 to 8.5 as the concentration of the salt reaches 4.0 oz./gal. which addition, the authors note, should have little effect on the pH of the solution.

The additional curves shown, wherein sodium hydroxide was added to solutions containing 2 and 9 oz./gal. of sodium carbonate respectively, indicate that, above pH 12.0, the highly alkaline solutions will show little effect with small changes in hydroxide concentration; at pH values of 11.0 and 12.0, more pronounced changes in pH will result with slight changes in hydroxide concentration, and at pH values below 11.0. Carbonate will buffer the solution against pH changes due to changes in hydroxide concentration.

With data made available, as represented in Fig. 212, the authors investigated the change in pH of a Rochelle salt-copper bath by varying the concentration of the constituents (other than copper cyanide) singly. The results tabulated in Table 1 show here too that sodium carbonate, sodium cyanide, and Rochelle salt have little effect on the pH of the bath. The addition, however, of sodium hydroxide to the bath results, as in the water solution, in an increase in pH. The effect indicates that the pH for this type of bath will vary with changes in hydroxide concentration. The causes for such changes are given as follows: acid or alkali carried over from cleaning; differences in electrode efficiencies; bath decomposition. The extent to which changes in hydroxide will affect the pH of the bath will be governed by the buffer effect.

To determine the buffer effect, several baths with varying composition (Table 2) were prepared. It was found that baths 1 to 9 had an initial pH of about 10.3 to 10.4, and baths 10 and 11, which did not contain sodium carbonate, showed an initial pH value of about 11.4. Sodium hydroxide was added in small amounts to a gallon of solution of each bath and the pH recorded for each addition. The values were then used to determine a pH caustic soda or buffer curve. The results were plotted in three composition curves Fig. 213) with curves 1 and 2 representing the effect of the caustic soda addition to the baths containing 2 and 9 oz./gal. respectively, and curve 3 that for baths in which sodium carbonate was omitted.

With the reference point chosen as pH 10.7, it is noted that the three curves are virtually the same above this pH value, an indication of what little effect changes in concentrations of copper cyanide, sodium cyanide, or Rochelle salt have upon the pH. However, when the pH value is below 10.7, curves 1 and 2, representing the baths containing sodium carbonate, show clearly the buffered effect; whereas, the baths represented in curve 3, in which sodium carbonate is absent, are not buffered. Further analysis of the graph shows that, for baths containing carbonate (curves 1 and 2) with a pH of 12.0 or less, the drop in pH with a small decrease in hydroxide concentration will be sharp until a pH of 10.3 or 10.4 is reached, at which point the pH becomes comparatively constant. For the baths without sodium carbonate, however, (curve 3), the pH, it is observed, continues to fall to pH values of 8 or 9 with small decreases in hydroxide concentration.

The suggestion is advanced that the flat part of the buffer curve, which corresponds to a pH value above 12, is the easiest range to maintain. The pH between 11.0 and 12.0 is readily affected by changes in hydroxide concentration.

Anode Current Density

Excessive anode polarization in the Rochelle salt copper cyanide bath results from anode current densities in excess of safe limiting values, a condition introduced with the use of high current densities at relatively high current efficiency. A study of the limiting anode current density for various bath compositions, as well as the effect of pH on anode behavior, was made by Graham and Read.

TABLE II. Bath Compositions Studied

Bath No.	CuCn oz./gal.	Free NaCN oz./gal.	Rochelle salt oz./gal.	Soda ash oz./gal.	Variable
1	3.5	0.75	4	2	Reference bath
2	3.5	2.0	4	2	Higher free cyanide
3	3.5	0.75	4	9	Higher carbonate
4	4.0	1.6		2	No tartrate
5	5.5	0.75	4	2	Higher metal
6	7.0	0.75	4	2	Still higher metal
7	3.5	0.75	8	2	Higher tartrate
8	3.5	0.75	8	9	High tartrate & carbonate
9	7.0	0.75	8	2	High metal & tartrate
10	3.5	0.75	4	0	No carbonate
11	3.5	0.75	8	0	High tartrate, no carbonate

The baths indicated in Table 2 were used. The anodes were one-quarter inch copper rods immersed to a depth of three and three-quarter inches in a 2 liter beaker, equidistant from a sheet copper cathode shaped to fit to the

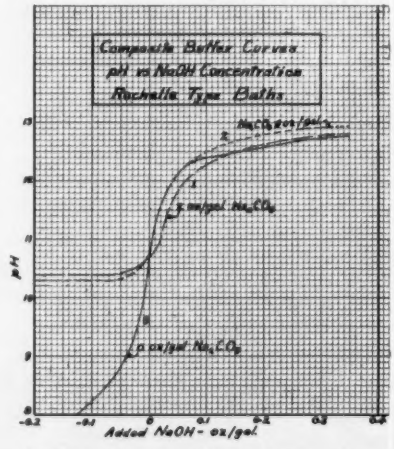

Fig. 213. Composite buffer curves; pH vs. NaOH concentration; Rochelle type baths.

side of the beaker. A low current density was applied to determine the anode polarization. Current density was increased after each potential measurement and the corresponding anode polarization recorded.

The relationship of anode polarization to current density at pH values of 12.8 and 10.7 for the baths indicated in Table 2 is shown in Figs. 214 and 215. The curves in the pH graph with a pH of 12.8, representing baths 1, 5 and 6 in Table 2, with a varying copper cyanide concentration of 3.5, 5.5 and 7.0 oz./gal. respectively and a constant sodium cyanide concentration limiting current density is practically the same between 19 and 23 amp./ft.^{2}, with the polarization jump (designated by the arrow) occurring at lower voltages in the more concentrated baths.

In the case of curve 2 (bath 2) corresponding to a bath with 0.2 oz./gal. free cyanide, although the polarization jump occurs at about the same voltage as that for bath 1, the limiting anode current density is increased to about 24 amp./ft.^{2}.

Curve 3, representing a bath composition of 9 oz./gal. soda ash (bath 3), shows that the limiting current density may be raised to more than 72 amp./ft.^{2} before excessive polarization of the copper anode occurs.

Curve 10 for bath 10, with no soda ash (carbonate), compares with curve 1 in limiting current density; curve 4, representing the conventional cyanide bath (without Rochelle salt) with 2 oz./gal. carbonate, and 1.6 oz./gal. free cyanide, permits a low current density of about 12 amp./ft.^{2}.

Consideration of curve 4, with a pH of 10.7, shows that, with a high carbonate concentration (curve 3), polarization of the copper anode does not occur until a current density of 81 amp./ft.^{2} is applied. Increasing metal concentration (baths and curves 1, 5, 6) has a much less marked effect upon polarization, the exception being bath 6 with a limiting current density of about 31-36 amp./ft.^{2} for excessive polarization instead of the limiting current density of 25 amp./ft.^{2} for the others. Curve 4 (bath 4), the common cyanide solution, emphasizes again the inferiority of this solution compared to the tartrate bath containing carbonate. Curve 10 (bath 10) containing no carbonate, with excessive polarization occurring for a limiting current density as low as 12 amp./ft.^{2} is convincing

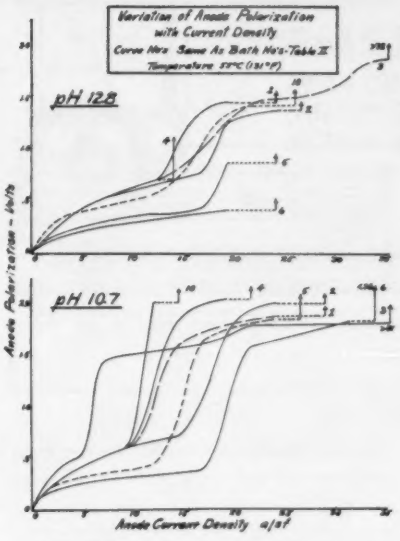

Fig. 214 (Top) and Fig. 215 (Bottom).

evidence of the need for adding carbonate to a Rochelle salt bath.

The authors conclude, on the basis of results obtained, that: anode current density and pH are governing factors in the excessive polarization of copper anodes; addition of tartrates does not remedy this effect; high carbonate concentrations in the Rochelle salt-copper baths permit the use of high anode current densities without excessive polarization of the anode; free cyanide concentration has little effect on the polarization-current density relationship; for a pH value of 13.3 the copper anode acts like an insoluble anode so that a high current density is possible in a Rochelle salt-copper bath containing carbonate, but the anode efficiency is virtually zero; the limiting anode current density for copper is generally less than 30 amp./ft.^{2} except in baths with a high carbonate concentration; a Rochelle salt concentration between 4 and 8 oz./gal. is satisfactory.

Citrate Addition

A comparative study was made by C. W. Smith and C. E. Minton in respect to the use of other organic acids (salts), such as citrates, in place of Rochelle salts in a copper cyanide bath. For this study, a potassium-sodium citrate-copper cyanide bath was connected in series with a Rochelle salt copper bath and an acid copper bath, with the latter operating at 99 per cent efficiency, serving also as the coulometer. Identical compositions were used for both the citrate and Rochelle salt baths, with the difference between the two limited to the use of sodium hydroxide for adjusting the pH in the Rochelle salt, and potassium hydroxide for the citrate bath. The composition of each bath was as follows: Copper, 1.95 oz./gal.; free cyanide, 0.75 oz./gal.; carbonate, 2 oz./gal.; Rochelle salt (or sodium citrate for the citrate bath), 4 oz./gal.; pH 12.6 (NaOH or KOH). The low cyanide/metal ratio compares with that used by Graham and Read. Five runs were made with each of three series, with variations in Rochelle (or citrate) concentrations of 4.6 and 8 oz./gal. and increases in carbonate concentration up to 14 oz./gal.

Results indicated the following comparable facts: the character of the cathode deposits from the citrate bath is superior in appearance to those from the Rochelle salt bath, with greater luster and more uniformity in color and grain as well as less tendency toward burning or roughness; an anode current density of 50 amp./ft.^{2} in the citrate bath gave an 18.3 per cent average lower anode efficiency than in the Rochelle bath. (When the sodium citrate or Rochelle salt concentrations were 6 oz./gal. for each bath, the average anode efficiency for this concentration for five runs was 69.6 per cent for the Rochelle salt bath against 51.3 per cent for the citrate bath); the cathode efficiency of a potassium-sodium citrate-copper cyanide bath is about 7.5 per cent lower than that for a Rochelle salt bath under similar conditions; thus, for the 6 oz./gal. Rochelle salt or citrate bath, the average cathode efficiencies were 51.9 per cent and 43.5 per cent respectively and, for the 8 oz./gal. series, the cathode efficiencies were 52.8 per cent for the Rochelle salt bath against 41.5 per cent for the citrate bath.

(*To be continued*)

CORRECTION

In the article entitled "Treatment of Combined Finishing Wastes" by Dr. A. G. Winger in our November 1959 issue, credit is given on page 63 to A. G. Feigler of American Water Softener Co., Inc. The correct spelling of the name is Zeigler, and apologies are extended to Mr. Zeigler for the misspelling of his name.

SHOP PROBLEMS

BARREL FINISHING — POLISHING AND BUFFING
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RUSTPROOFING — LACQUERING AND ENAMELING

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Stress Relief in Nickel Baths

Question: We have been told that saccharin can be added to a Watts barrel nickel bath to relieve stress. Can you inform us as to the amounts required, also whether other materials can be substituted for the saccharin?

H. R. D.

Answer: Saccharin is added in the amount of 1-2 grams/liter for stress relief in nickel plating (13-26 oz. per 100 gallons). Other materials which are suitable are the following:

Toluene-p-sulfonic acid
Benzene-m-disulfonic acid
Toluene-p-sulfonamide
Naphthalene-1,3,-6-trisulfonic acid
Naphthalene-1,5-disulfonic acid

Black Chromium

Question: Could you advise us where we could get information regarding the deposition of black chrome? Also equipment and current requirements if substantially different from that customarily used for chrome plating.

E. I.

Answer: Black chromium deposits can be produced from the following baths:

1.	Chromic acid	33 oz./gal.
	Acetic acid	0.4 "
	Current density	1,000-1,500 amp./ft.^{2}
	Temperature	Below 60° F.
2.	Chromic acid	27 oz./gal.
	Nickel chloride	2.7 "
	Vanadium, as nitrate	0.3 "
	Acetic acid	0.7 "
	Current density	950 amp.ft.^{2}
	Temperature	85-95° F.

Both processes will require d.c. equipment which will deliver 12-15 volts, because of the high current density employed, and also cooling coils.

A new process using fluoride as a catalyst has become available recently, and we are referring you to the supplier.

Tanks for Nickel and Chromium

Question: I would like some information on plating tanks made of stainless steel. Can nickel and chrome be used in these tanks? If so, can they be heated with open gas burners from the bottom?

R. L. J.

Answer: Stainless steel tanks are not recommended for nickel or chromium plating solutions.

For nickel plating, a rubber-lined or plastic tank can be placed in a steel water jacket for direct gas heating. A chromium tank can also be heated in this manner, or you can use a lead lined tank with a thick sheet of steel between the tank bottom and the gas flame.

Forming After Nickel Plating

Question: We have a tarnishing or corrosion problem on nickel plating of steel parts. We tried some with a copper flash and 0.0001 nickel and some with just 0.0001 nickel and no copper undercoat. These parts are crimped after plating and the tarnishing shows up on the crimped edge.

According to some tests we ran, we found we were getting better results with straight nickel and no copper undercoat. How do you feel about this?

A. C.

Answer: The corrosion is probably due to a combination of brittleness of the nickel plate and opening of the grain of the steel during crimping.

Since copper is a softer metal than steel, there will be more tendency for the nickel to pull away when stressed, so nickel direct on steel would be preferred. It is suggested that the nickel solution be purified so that the deposits will be of maximum ductility, and operated at the highest practicable temperature and lowest pH. Also, a heavier deposit is suggested, since 0.0001" of nickel cannot be expected to offer much protection against corrosion.

Blackening Silver

Question: Please send me some additional information on blackening silver with tellurium chloride. How much water is used for diluting? Can the solution be used cold?

W. B. M.

Answer: The stock solution of tellurium chloride can be used all the way from full strength or diluted with equal parts of water for application by brush or sponge, down to 4 oz. of stock to a gallon of water for dipping. Action is very slow at room temperature and either the part or the solution should be heated.

Testing Anodized Aluminum

Question: Is there a means of testing an aluminum part which has been anodized and dyed black to determine the process by which it was anodized; sulfuric acid coating or chromic acid coating?

I am also interested in testing anodize for hot water or dichromate seal.

B. E. B.

Answer: Qualitative analysis for the presence of chromium in the oxide film will be necessary to determine whether the chromic or sulfuric process was used for anodizing.

Since dichromate sealing is used only for sulfuric acid anodized aluminum, the presence of the yellow color in the film is usually sufficient for identification. However, if it is necessary to distinguish between dichromate sealing and a yellow dye, a qualitative test for chromium in the film will be required.

Silver-Lustre

Question: How is the silver-lustre finish produced on ceramics and glass and how is it kept from tarnishing, as does all other silver? I tested a small vase that I purchased recently, and it

doesn't appear to have any protective lacquer, but the finish doesn't show the slightest signs of darkening.

D. P. L.

Answer: "Silver-lustre" is a misnomer, although the term has probably been in use since the late 1700's. For the last hundred years the film has been produced by the use of platinum, which accounts for the tarnish resistance. Gold is also popular as a lustre finish, using liquid preparations of metal salt and various oils which are applied to the ceramic surface and then fired. Proprietary mixtures are generally employed, to avoid the trouble of preparing the coating materials, and the name of a supplier is enclosed.

Coloring Pewter

Question: We are interested in a method for producing a black antique finish on pewter, similar to that on Swedish articles we have seen. Any information you can furnish us will be appreciated.

N. D. L.

Answer: This finish is produced electrolytically. The pewter is treated anodically to activate the surface, using a 50 g/l solution of caustic soda, at 4-5 volts for 10-15 minutes. The temperature of the solution should be about 80°C. After activation, the surface is blackened by reverse current treatment at 3-4 volts for 10-15 minutes, also at 80°C., in a solution of 100 g/l trisodium phosphate and 20 g/l phosphoric acid. The solution composition is not critical, but the pH should be maintained at about 5 to 7.

After blackening, the parts are highlighted with a greaseless wheel or with pumice and water, using a scratch-brush.

Burnishing Balls

Question: We are desirous of ball burnishing die castings to obtain a suitable surface for bright nickel and chrome and, in this country, we are able to obtain unfinished hardened chrome steel balls for 3/8 the price that we have to pay for polished hardened chrome steel balls.

We enclose a sample of both balls, and would appreciate it if you could advise us whether or not the unfinished ones would be suitable.

P. B.

Answer: The unfinished hardened chrome steel balls forwarded with your letter are unsuitable for ball burnishing. The balls could be finished by tumbling with abrasive, followed by leather scraps and lime but the cost will then be the same, if not more, than polished balls.

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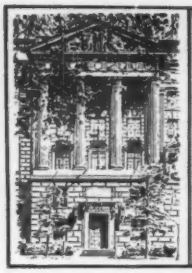

Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

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Pickling Waste Recovery

U. S. Patent 2,880,061. *Mar.* 31, 1959. *G. E. Muns and D. C. Berkebile, assignors to Crucible Steel Co. of America*

The method of treating iron sulfate containing pickle liquor with raw coke oven gas for purifying said gas and recovering useful values which comprises: reacting raw coke oven gas with iron sulfate containing pickle liquor and completing the reaction at a pH of about 7.5-7.8, thereby to precipitate substantially all ferrous iron present as insoluble iron sulfide and ammonium-ferrocyanides in an aqueous slurry containing ammonium sulfate in solution, oxidizing the entire resulting slurry to convert the iron sulfide into insoluble iron oxide and free sulfur, continuing the oxidation until the iron sulfide is reduced to not less than about 0.2-0.5% by weight of the total slurry, separating the ammonium sulfate solution from said slurry, separating the sulfur from the resulting slurry by flotation, treating the residue with alkali to solubilize the ferrocyanides, and separating the solubilized ferrocyanides from the insoluble iron oxide.

Cleaning Hollow Parts

U. S. Patent 2,880,433. *Apr.* 7, 1959. *J. L. Pettit and R. M. Geisler, assignors to Metalwash Machinery Co.*

A machine for brushing hollow cylindrical work pieces.

Organic Protective Coatings

U. S. Patent 2,881,091. *Apr.* 7, 1959. *R. E. Schulze, assignor to Culligan, Inc.*

The method of protecting a galvanized surface against corrosion, comprising the steps of roughening the galvanized surface to increase its surface area and to remove oxide films, applying a primer base to the roughened surface with said primer base consisting of granules of a non-leafing type aluminum suspended in a vehicle in which the ratio of aluminum granules is approximately two to four times that of the vehicle solids, applying a finishing material over said primer base, and curing said finishing material.

Supersonic Spraying

U. S. Patent 2,881,092. *Apr.* 7, 1959. *J. Sedlacsik, Jr.*

Apparatus for coating an object by spraying an electrostatically charged liquid in a fine mist-like jet on said object, comprising nozzle means for projecting a mixture of the liquid and a motive agent, means for receiving the projected mixture of the liquid and motive agent from said nozzle means, said latter means being capable of supersonic vibration and having a free forward knife edge, means for supersonically vibrating said receiving means so as to apply compressional waves at a surface of the mixture of the liquid and motive agent discharged onto said receiving means, and means including a high-voltage source electrically connected, respectively, to said receiving means and to the object to be coated for maintaining an atomizing electrostatic field adjacent the free forward knife edge of said receiving means.

Bright Nickel Bath

U. S. Patent 2,881,120. *Apr.* 7, 1959. *J. L. Towle and J. K. Long*

A process for electroplating bright ductile nickel deposits, the solution containing cooperating brightening agents, one of said co-operating brightening agents being selected from the group consisting of aromatic sulfonamides and aromatic sulfonates.

Rust Inhibiting Composition

U. S. Patent 2,881,140. *Apr.* 7, 1959. *R. W. Schrum, assignor to Sinclair Refining Co.*

A composition consisting essentially of about 50 to 95 weight per cent of an aromatic hydrocarbon solvent, about 5 to 65 weight per cent of an oxidate of a foots oil fraction and about 0.1 to 4 weight per cent of a substantially dehydrated partially oxidized microcrystalline wax having a saponification number of about 10 to 150, said foots oil oxidate having a melting point of about 80 to 95° F., an API gravity of about 10 to 25 and a saponification number of about 200 to 325.

Gas Plating

U. S. Patent 2,881,094. *Apr.* 7, 1959. *T. B. Hoover, assignor to the United States of America*

An improved process of nickel plating a surface which comprises effecting contact of said surface with a mixture comprising nickel vapor together with approximately 0.1% to approximately 1% H_2S, by volume, while maintaining the surface-gas interface during said contact at a temperature of approximately 60° C. to approximately 100° C.

Bright Copper Bath

U. S. Patent 2,881,121. *Apr.* 7, 1959. *D. G. Foulke, O. Kardos and H. Koretzky, assignors to Hanson-Van Winkle-Munning Co.*

A process for producing a bright copper electroplate which comprises electrodepositing copper from an aqueous alkaline cyanide copper plating bath in which there is dissolved from 0.01 to 20 millimoles per liter of an alkali-soluble selenium compound and from 0.005 to 200 millimoles per liter of a water-soluble acetylenic compound.

Bright Copper Bath

U. S. Patent 2,881,122. *Apr.* 7, 1959. *D. G. Foulke, O. Kardos and H. Koretzky, assignors to Hanson-Van Winkle-Munning Co.*

A process for producing a bright copper electroplate which comprises electrodepositing copper from an aqueous alkaline cyanide copper plating bath in which there is dissolved from 0.001 to 1 millmole per liter of an alkali-soluble tellurium compound, and from 1 to 250 millimoles per liter of a water-soluble acetylenic compound.

Gas Plating

U. S. Patent 2,881,518. *Apr.* 14, 1959. *H. A. Toulmin, Jr., assignor to The Commonwealth Engineering Co. of Ohio*

In a continuous process of the character described, the improvement

which comprises establishing an alkyl metal vapor atmosphere, continuously casting a hot metal shape at a temperature high enough for such shape readily to acquire an oxide scale in air, cooling the hot cast shape to a temperature range of 300 to 600° F., thereafter introducing said cast hot metal shape into said alkyl metal vapor atmosphere, maintaining the hot cast shape in said atmosphere while the same is at a temperature to cause thermal decomposition of said metal vapor until it is substantially completely coated by an adhering film of the product resulting from thermal decomposition of said vapor by contact thereof with the hot cast shape, subjecting the resultant plated metal shape to a temperature of 800 to 1200° F. to increase the adhesion and ductility of the coating whereby the surface of the hot cast shape is protected from oxidation by a protective coating of metal.

Aluminum Etch

U. S. Patent 2,882,134. *Apr.* 14, 1959. *S. Spring and R. H. Elliott, Jr, assignors to Pennsalt Chemicals Corp.*

A method of etching aluminum which comprises subjecting the aluminum to the action of an etching solution having a temperature of 120 to 180° F. said etching solution containing a concentration of about 1 to about 15% of an etching alkali selected from the class consisting of sodium and potassium alkalies, about 4% to about 10% by weight, based upon the etching alkali content of the solution, of tartaric acid, and about 0.2 to about 1.0% by weight, based upon the etching alkali content of the solution, of an alkali metal salt of ethylene diaminetetraacetic acid.

Aluminum Etch

U. S. Patent 2,882,135. *Apr.* 14, 1959. *R. H. Elliott, Jr., assignor to Pennsalt Chemicals Corp.*

In the etching of aluminum involving the step of immersing aluminum in an aqueous alkaline etching bath containing from 1% to 15% of etching alkali maintained at a temperature of from 110° to 200° F. and containing from 0.8% to 6%, based on the weight of the etching alkali, of a scale inhibitor effective in preventing alkali aluminates forming during the etching operation from depositing as a scale, the method of decreasing the etching rate comprising the step of including in said etching bath a metal ion selected from the group consisting of strontium, barium and calcium ions in amounts ranging from 3% to 140% based on the weight of the scale inhibitor.

Folded Buff

U. S. Patent 2,882,139. *Apr.* 14, 1959. *A. S. Rock, assignor to F. L. & J. C. Codman Co.*

The process which comprises detaching and spreading out into the form of a cylindrical band the fabric from each of two used buffing sections of known type wherein a wide cylindrical band of plied fabric is folded outwardly about its center line and secured in folded position by mechanical gripping jaws clampingly engaging the same in a radially shallow zone adjacent the fold line, which sections have been worn away to approximately half their radial depth, joining one circumferential edge of each to a circumferential edge of the other by means not substantially increasing the thickness adjacent the line of juncture, folding them outwardly along their line of juncture into side-by-side relationship and securing the joined circumferential portions to a supporting center, thereby to produce a single full-sized section charged throughout its circumference and to a substantial radial depth with buffing compound.

Phosphate Coating

U. S. Patent 2,882,189. *Apr.* 14, 1959. *W. S. Russell and R. C. Gibson, assignors to Parker Rust Proof Co.*

The method of treating ferrous surfaces to increase their resistance to corrosion and improve the adherence thereto of organic siccative finishes which comprises providing an iron phosphate coating thereon, rinsing said phosphate-coated surface with a concentrated solution of a hexavalent chromium compound, and drying said rinse on said surface, controlling the concentration of said rinse solution and the conditions of said rinsing operation so as to deposit an overlayer of hexavalent chromium compound on said surface weighing at least 0.6 mg./sq. ft. and not more than about 15 mg./sq. ft. calculated as CrO_3.

Bright Nickel

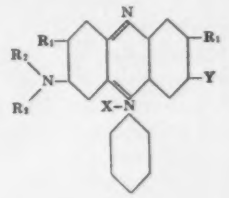
U. S. Patent 2,882,208. *Apr.* 14, 1959. *D. H. Becking, R. J. Clauss and H. Brown, assignors to The Udylite Research Corp.*

A bath for electrodepositing bright, ductile nickel plate having dissolved therein about 0.1 gram/liter to saturation of at least one organic sulfoncompound, and about 0.001 to about 0.015 gram/liter of a nitrile.

Acid Copper Addition Agent

U. S. Patent 2,882,209. *Apr.* 14, 1959. *H. Brown and R. A. Fellows, assignors to The Udylite Research Corp.*

A bath for the electrodeposition of copper comprising an aqueous acidic solution of a material selected from the group consisting of copper sulfate and copper nitrate, about 0.002 gram/liter to about 0.03 gram/liter of a compound selected from the group consisting of thiohydantoin, 1-acetyl-2-thiohydantoin, 1-propionyl-2-thiohydantoin and 1-trifluoro acetyl 2-thiohydantoin, and 0.0015 to 0.05 gram/liter of a compound having the structure:



Wire Plating

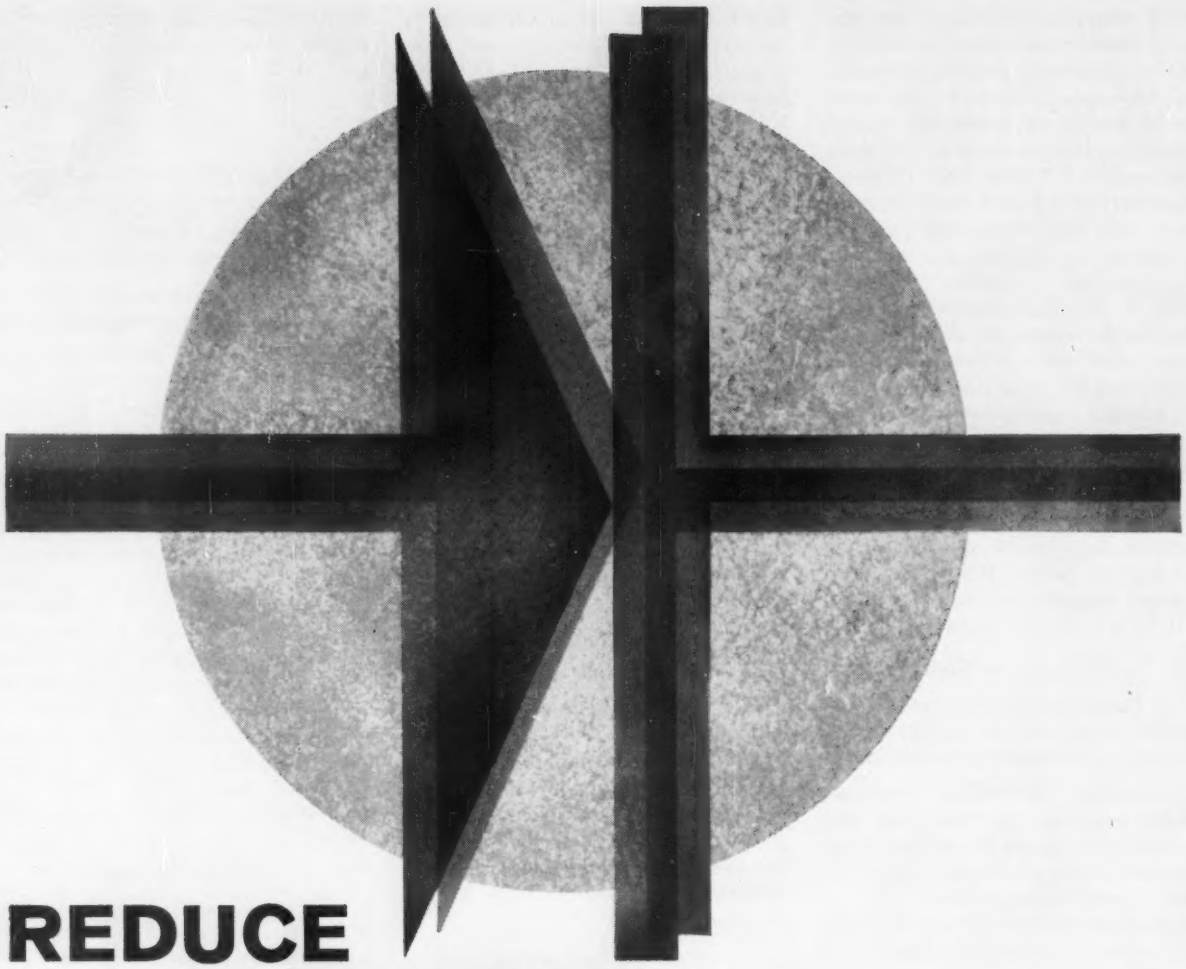
U. S. Patent 2,882,214. *Apr.* 14, 1959. *W. J. Summers and H. P. Hasell, assignors to Westinghouse Electric Corp.*

A positive contact assembly between a plurality of wires to be plated and a source of electrical power and comprising mounting and supporting means, a reservoir on said mounting and supporting means, mercury in said reservoir and covered with a protective film of water to prevent oxidation of said mercury and the escape of vapors therefrom and for cooling said mercury to prevent enhanced vaporization therefrom, a pulley shaft in said mounting and supporting means above said reservoir, a plurality of electrically conducting contact pulleys on said shaft, each of said pulleys being in contact with one of said wires and said mercury and means on said supporting and mounting means for washing said pulleys and said wires and providing said protective film on said mercury.

Buffing Wheel Structure

U. S. Patent 2,882,653. *Apr.* 21, 1959. *J. C. Wisnieski, assignor to Lyon, Inc.*

In a buffing wheel structure, an an-



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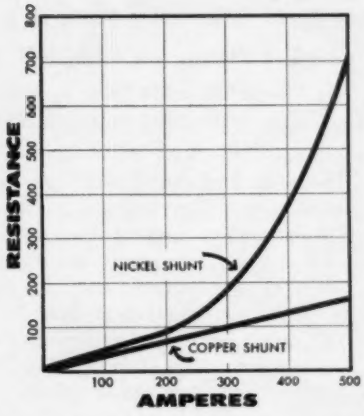

When any brush accepts more than its proportional share of current, the temperature of the shunt rises, its resistance increases and current is immediately distributed equally among the other brushes.

Use of a braided nickel shunt is *exclusive* with H-VW-M. The new H-VW-M Equaload Brush is designed to fit all makes of DC generators.

H-VW-M Form "A" Tank Rheostats – Designed to eliminate all switch failures caused by excessive heating. Standard sizes available with ratings from 30 to 1000 amps. Larger sizes to 5000 amps can be furnished.

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H-VW-M Motor Generator Sets – Available up to 50,000 amps. Standard voltage ratings are from 6 to 250 volts.

H-VW-M H-VW-M H-VW-M

nular spacer plate ring having along its inner margin spacer fingers for concentricity engagement with a buff hub ring and along the outer margin penetrating prongs for engagement within a buff ring assembled on an associated hub ring.

Buffing Wheel

U. S. Patent 2,882,654. *Apr.* 21, 1959. *S. C. Mockiewicz and J. H. Bacha, assignors to American Buff Co.*

A buffing wheel of disc shape comprising a buffing portion of pleated, abrasive coated, single ply cloth discs of uniformly alternate long and short portions forming pleats wherein said abrasive coated cloth comprises a flexible bonding material on one surface of the cloth.

Spray Booths

U. S. Patent 2,883,170. *Apr.* 21, 1959. *N. B. Trittipoe, assignor to Westfield Sheet Metal Works, Inc.*

A spray booth having a liquid-containing settling tank at the bottom thereof.

Immersion Silver Bath

U. S. Patent 2,883,288. *Apr.* 21, 1959. *D. L. Dobbs, R. F. Gill, Jr., and R. B. Howes, assignors to Lewco, Inc.*

A plating bath for the deposition of silver upon a copper-containing metal surface by chemical displacement consisting essentially of an acidified solution of thiourea, a silver salt, an acidifying agent, and sulfide ions, said solution having a pH of between 1.0 and 2.4 and providing silver ions in sufficient concentration to effect a useful silver deposit upon said metal surface, said thiourea being present in an amount equal to from about 16 to about 79 times the weight of silver, and said sulfide ions being present in an effective amount but less than about 10 grams per liter of solution.

Rust Preventive

U. S. Patent 2,883,289. *Apr.* 21, 1959. *M. J. Furey and E. O. Forster, assignors to Esso Research and Engineering Co.*

A coating composition adapted to prevent rusting consisting essentially of a major proportion of a cutback asphalt and from about 0.1 to 10.0 wt. per cent of a zirconium salt of an aliphatic monocarboxylic acid having about 12 to 24 carbon atoms per molecule.

Electrostatic Coating

U. S. Patent 2,883,302. *Apr.* 21, 1959. *E. M. Ransburg, assignor to Ransburg Electro-Coating Corp.*

A method of electrostatically coating articles each having extended side surfaces and relatively sharply curved edge portions.

Conversion Coating — Aluminum

U. S. Patent 2,883,311. *Apr.* 21, 1959. *D. Halpert, assignor to Vertol Aircraft Corp.*

The process of treating aluminum and its alloys which comprises immersing the metal in an aqueous solution containing 8 to 98% nitric acid (70% concentrate) and containing fluoride and chromate ions in concentrations corresponding to that obtained in a solution containing 1 to 45 grams of sodium fluoride per liter of solution and 1 to 400 grams of anhydrous chromic acid per liter of solution for a time sufficient to initially reduce the surface resistance of the metal to below 100 microhms, removing the metal from said aqueous solution before the surface resistance again reaches 100 microhms and thereafter rinsing the thus treated metal.

Belt Polishing

U. S. Patent 2,883,804. *Apr.* 28, 1959. *I. E. Hjelstrom and J. B. Catlett, assignors to Curtiss-Wright Corp.*

The method of polishing the surface of a metal workpiece which consists in passing an abrasive polishing belt at high speed over the metal surface, with the abrasive surface of the belt spaced from but in close proximity to the metal surface, and driving the belt from its normal run into elastic engagement with the workpiece solely with the application of a high speed fluid jet to the other side of the belt.

Polishing Apparatus

U. S. Patent 2,883,809. *Apr.* 28, 1959. *L. G. Simjian, assignor to The Reflectone Corp.*

The method of abrading the surface of an article that comprises placing the article in a bath of magnetizable fluent material at a time when said magnetizable material is not magnetized and is therefore fluent to permit the insertion of the article thereinto with the surfaces of the article to be abraded inundated in said bath, magnetizing said fluent material to render the bath nonfluent with the magnetizable material

in intimate contact with the surfaces of the article to be abraded, and thereafter de-magnetizing and magnetizing said bath at predetermined intervals with the article movable in said bath relatively to said fluent material while said fluent material is not magnetized.

Electroless Nickel

U. S. Patent 2,884,344. *Apr.* 28, 1959. *E. R. Ramirez, assignor to Reynolds Metals Co.*

A chemical nickel cation hypophosphite anion plating solution containing an aggregate amount of approximately 0.1 to 100 parts per million by weight of the solution of at least two of the metallic elements of Group Va of the periodic system, the two metallic elements being present in ratios ranging from about 1:5 to 1:0.5.

Plating on Uranium

U. S. Patent 2,884,364. *Apr.* 28, 1959. *E. W. Rebol and R. F. Wehrmann, assignors to the United States of America*

The process of preparing an electroplated uranium article, which comprises pickling the uranium metal with aqueous trichloroacetic acid, treating the pickled uranium with nitric acid and then electroplating a metal coating upon the metallic uranium.

Electrostatic Spraying

U. S. Patent 2,884,341. *Apr.* 28, 1959. *J. W. Juvinall, assignor to Ransburg Electro-Coating Corp.*

A method of electrostatically spray coating a plurality of vertically elongated articles.

Rust Inhibitor Composition

U. S. Patent 2,884,379. *Apr.* 28, 1959. *H. W. Rudel and M. Gargisa, assignors to Esso Research and Engineering Co.*

A rust-inhibiting composition of matter comprising a major portion of a mineral oil containing about 0.005 to about 0.20 weight per cent, based on the weight of the total composition, of a rust preventive consisting essentially of an isomeric mixture of acids having the formula:

RSR'COOH

Sandblast Tool

U. S. Patent 2,884,745. *May* 5, 1959. *M. E. Fritze and J. W. Smith, said Smith assignor to J. C. Fennelly Co.*

A tool for sandblasting the interior of a pipe and the like.

Spraying Method

U. S. Patent 2,884,897. *May* 5, 1959. *S. E. Richeson*

Apparatus for spray coating the exterior surfaces of similar articles comprising, in combination, a conveyor for carrying the articles to be spray coated along an arcuate path through a spraying station from one initial terminal end to a final terminal end, and spraying means supported adjacent to said final terminal end of said path.

Gas Plating

U. S. Patent 2,885,301. *May* 5, 1959. *G. A. Samuel, assignor to Metal Diffusions, Inc.*

The method of chromizing iron and steel parts, which comprises coating the parts with a composition essentially comprising powdered glass, a source of chromium, a chromium halide, and a bodying material, and subjecting the parts thus coated to a temperature of between 1600 and 2300 degrees F.

Conversion Coating

U. S. Patent 2,885,312. *May* 5, 1959. *L. M. McDonald, assignor to Kelite Corp.*

A corrosion protective composition for metals comprising an aqueous coating bath including a major proportion of a water-soluble inorganic component reactive with said metal to provide a corrosion-resistant coating thereon and a minor proportion of from about 10-20% by weight based on said water-soluble inorganic component of a polymeric material containing a strong polar grouping selected from the group consisting of polystyrene sulfonic acid, polystrene phosphonic acid, styrene heteropolymer of ammonium maleate and polystyrene sulfonic acid ammonium salt.

Conversion Coating — Aluminum

U. S. Patent 2,885,313. *May* 5, 1959. *S. R. Milliken, assignor to Aluminum Co. of America*

The method of treating finished or semi-finished articles composed of aluminum base alloy containing from 0.1 to 15 percent magnesium comprising the steps of coating said articles with an organic ammonium fluoroborate which yields BF_3 when heated to a temperature above 400° F. but below 750° F., and heating said coated article to a temperature between 400 and 750° F., but in all cases below the critical oxidation temperature of said alloy, for a period of time sufficiently long to cause substantial disappearance of the organic substance.

Conversion Coating — Aluminum

U. S. Patent 2,885,315. *May* 5, 1959. *S. R. Milliken, assignor to Aluminum Co. of America*

The method of treating finished or semi-finished articles composed of an aluminum base alloy containing from 0.1 to 15 per cent magnesium comprising exposing said articles to an atmosphere containing at least 75 milligrams of boron trifluoride vapor per cubic foot of furnace atmosphere for a period from one to forty-five minutes at a temperature between 400° F. and 750° F., but below the critical oxidation temperature of said alloy.

Nickel Plating on Carbides

U. S. Patent 2,885,329. *May* 5, 1959. *H. L. Slatin, assignor to the United States of America*

The method of electro-nickel plating articles comprising wolfram carbide which comprises making the article anodic at a current density from 1 to 5 amperes per square inch in an aqueous solution containing from 100 to 250 grams per liter of sodium pyrophosphate for a time of from 10 to 30 minutes within a temperature range of from 20° to 60° C., and then electrolytically depositing a nickel coating on the resultant etched surface from an aqueous nickel salt solution.

Bright Cadmium and Zinc Baths

U. S. Patent 2,885,330. *May* 5, 1959. *J. Levy, assignor to The Trubek Laboratories*

An aqueous alkali cyanide bath for use in electroplating, said bath containing metal ions selected from the group consisting of zinc and cadmium, together with a formyl substituted phenyl ether.

Bright Copper Bath

U. S. Patent 2,885,331. *May* 5, 1959. *H. G. McLeod and D. A. Swalheim, assignors to E. I. du Pont de Nemours and Co.*

In a process for the electrodeposition of bright copper deposits from an aqueous cyanide copper plating bath containing hexavalent chromium ions, in a concentration in excess of 5 p.p.m., the step of maintaining a sufficient amount, less than 1,000 p.p.m., of

stannous tin ions in said bath to prevent the concentration of said chromium ions from exceeding 5 p.p.m.

Buffing Wheel

U. S. Patent 2,885,834. *May* 12, 1959. *A. S. Rock, assignor to F. L. & J. C. Codman Co.*

A buffing wheel comprising a center and an annular mass of buffing material firmly secured thereto and comprising a pair of annuli set side by side and anchored to the center in such side by side position at their inner peripheries, each annulus consisting of a series of generally quadrilateral slabs each of which is of bias fabric strip folded up to provide multiple plies with bias presentation of the threads at the outer periphery and doubled edges adjacent the radial boundaries of the slab.

Electroless Nickel

U. S. Patent 2,886,451. *May* 12, 1959. *P. Budininkas, assignor to General American Transportation Corp.*

The process of regenerating a depleted aqueous chemical nickel plating solution containing desirable nickel cations and hypophosphite anions and undesirable phosphite anions and having a pH below about 5.5, comprising adding to the depleted plating solution both an alkaline earth hydroxide and an alkaline earth salt of a mineral acid, said addition supplying sufficient hydroxyl ions to the resulting solution to increase the pH thereof into the range 5.5 to 7.0, but not above, so as to precipitate therein alkaline earth phosphite, without precipitating therein any substantial amounts of alkaline earth hypophosphite or of any nickel compound, said addition supplying sufficient alkaline earth cations to the resulting solution to effect the removal therefrom of a substantial proportion of the phosphite anions therein, removing the precipitated alkaline earth phosphite from the resulting solution, and then adding to the resulting solution, the required nickel cations and hypophosphite anions and hydrogen ions to produce a plating solution of desired composition.

Spraying Device

U. S. Patent 2,885,998. *May* 12, 1959. *A. G. Farries, assignor to D. Napier & Son Ltd.*

Apparatus for applying a coating to a curved surface by means of a spray gun comprising two curved contour plates arranged in parallel planes, each plate corresponding to the profile of the curved surface in a selected plane.

Electroless Nickel

U. S. Patent 2,886,452. *May* 12, 1959. *N. L. Duvall, assignor to General American Transportation Corp.*

The process of regenerating a depleted aqueous chemical nickel plating solution containing desirable nickel cations and hypophosphite anions and undesirable phosphite anions, comprising treating the depleted plating solution to produce an ammoniacal solution thereof in which all of the nickel cations therein are in the nickel-ammonia complex, then adding to the ammoniacal solution alkaline earth hydroxide so as to precipitate therein alkaline earth phosphite without precipitating therein any substantial amounts of alkaline earth hypophosphite or of any nickel compound, said alkaline earth hydroxide addition to said ammoniacal solution being sufficient to effect the removal therefrom of a substantial proportion of the phosphite anions therein, removing the precipitated alkaline earth phosphite from the resulting solution, then removing ammonia from the resulting solution to break the nickel-ammonia complex therein, and then adding to the resulting solution the required nickel cations and hypophospite anions and hydrogen ions to produce a plating solution of desired composition.

Tin-Flowing Oil

U. S. Patent 2,886,465. *May* 12, 1959. *J. W. Nelson, assignor to Sinclair Refining Co.*

In hot dip tinning operations wherein freshly tinned steel plate is contacted with a bath of a tinning oil maintained at an elevated temperature, the step of contacting the tinned steel plate with a tinning oil consisting essentially of a blend of palm oil and pentatriacontenyl succinic acid anhydride, said anhydride being blended in an amount sufficient to increase the dewetting characteristics of the palm oil in hot dip tin plating operations.

Porcelain Enameling

U. S. Patent 2,886,463. *May* 12, 1959. *M. G. Liest, assignor to Allis-Chalmers Mfg. Co.*

A method of preparing a mild steel surface for enameling comprising the steps of: coating an article of mild steel with a ground coat of enamel; maturing the enamel by heating the coated article in an oxidizing atmosphere for a period of time equal to the time required for the enamel to assume a glossy fluid condition; extending the aforementioned maturing step for a further period of time to at least twice the period of time required to mature said enamel; and cooling the article to transform the enamel to a hard vitreous sheath firmly bonded to the steel article.

Gas Plating — Nickel

U. S. Patent 2,886,468. *May* 12, 1959. *T. B. Hoover and T. E. Zava, assignors to the United States of America*

An improved method of nickel plating a surface which comprises effecting contact of said surface with a mixture comprising approximately 5% to approximately 40% of nickel carbonyl vapor by volume, approximately 0.2% H_2S by volume, approximately 1% oxygen by volume and the remainder an inert carrier gas, while maintaining the surface-gas interface during said contact at approximately ambient atmospheric temperature, until the desired thickness of nickel on said surface has been obtained.

Cleaning-Phosphating Composition

U. S. Patent 2,886,477. *May* 12, 1959. *C. W. Smith*

An opalescent to clear, stable liquid composition for simultaneously cleaning and phosphating metal surfaces consisting essentially of about 50-80 per cent of an aqueous acidic phosphating solution; about 4-30 per cent of a hydrocarbon solvent for grease and oil; and about 10-30 total per cent of an emulsifier and an ethylene oxide condensation detergent, wherein said hydrocarbon solvent has an initial boiling point of about 200°-450° F. and a final boiling point below about 700° F.

ABSTRACTS

Use of Epoxy Resins in the Production of Modified Alkyd Resins

Paper read at European FATIPEC Congress, Lucerne.

With the testing of oil-modified penta-erythrite-epoxy-alkyds with a

high fatty acid content, which have been produced by the fat acid process, it has been established by R. J. Turner and G. Swift that these new resin types show superiority to the normal alkyd resins with respect to weathering resistance and resistance to aggressive atmospheres. The results of various comparative tests were presented and the advantages of these modified alkyd resins as compared with the normal alkyd-amino resin combination, were discussed.

The long oil alkyds, prepared from the epoxy resins, penta-erythrite and fatty acids, have shown themselves to be superior to the classical alkyds, particularly with regard to weathering resistance and anti-chalking behavior. Comparison was made of the results given by the alkyds short and moderate in oil, modified by the epoxy resins, with the results obtained from mixtures which had not been subjected to cooking. This comparison clearly showed the superiority of these new systems as compared with the classical binary mixtures of alkyd-melamine resins.

The Stability of Epoxy-Polyamide Systems

Paper read at European FATIPEC Congress, Lucerne.

The author dealt with the influence of various polymide types as well as the ratio of polyamide to epoxy resin, on the film characteristics of this type of finish. A comparison was made between systems of this type with amine-hardened epoxy resins and with epoxy-ester resins. In this connection, it was emphasized that the chemical resistance and the film strength are all the better, the higher the molecular weight of the polyamide.

Any transposition of the polyamide-epoxy resin ratio has a lesser influence than would be expected. The chemical resistance of the epoxy-polyamide resins can be designated as lying between that of the amine-hardened epoxy resins and the epoxy ester resins.

The following conclusions were arrived at, as a result of these investigations:

(a) The polyamide which, in general, gives the best results from the viewpoint of solidity of the film and resistance to chemical agencies, with the resins tested, was found to be the one with the highest molecular weight.

(b) The proportion of polyamide to epoxide resin is not as critical as would be expected. However, where differences do occur, it can be said that an excess of epoxide resin, within limits, is preferable to an excess of polyamide.

(c) The resistance to chemical agencies of the epoxide resin-polyamide systems, in general, is between that shown by the systems based on amines and that of the epoxidic esters. However, on some points, the combinations based on the polyamides are superior to those containing the amines, particularly wih regard to the resistance to shock and to boiling solutions.

Some New Hardening Mediums for Epoxy Resins

Paper read at European FATIPEC Congress, Lucerne.

A. H. Tawn and C. J. Trusselle studied hardening procedures with the epoxy resin systems. After a general consideration of the hardening media used, more detailed attention was given to some newer products, particularly special long-chained esters which contain amino groups. This new hardening medium for the epoxy resins, which is comparable to the polyamides, was investigated. Details were given of the influence of a hardening medium of this type on the characteristics of the epoxy resin finish films.

Investigation of Distribution of Electroplated Coatings

E. Raub: *Metalloberflaeche,* **12**, #12, 355-360.

Information applicable to practical electroplating was obtained from the plating tests conducted. If profiled parts with sharply profiled contours are being plated, distribution of the deposit from a copper cyanide bath is very much more uniform than with nickel plated coatings, so long as the electrolyte entry into the recesses is not greatly restricted. On the other hand, if narrow profiles are present then, with a marked restriction of the solution entry, the throwing power of the cyanide copper bath is then no better and, in some circumstances, can even be worse than that of the nickel bath. As against the normal rule in such cases, the throwing power of the copper bath can be improved by vigorous agitation of the electrolyte because, in this way, even within the recesses, a certain flow is produced.

On the basis of throwing power and metal distribution tests conducted, it can be said that, with sharp-edged profiles with an opening of less than 6 mm. with sufficient depth, a lack of fluid convection occurs which can act on the throwing-power characteristic of the cyanide copper bath. Even when the bath is agitated, however, in cyanide copper plating there is no better throwing-power than with the nickel platitng if, with a profile opening of 3 mm., the profile depth is 6 mm. and more. Accordingly, there is not always obtained the expected improvement in the coating over the whole of the part, if the nickel is partly replaced by cyanide copper.

Development of Drying and Simultaneously Polymerizable Melamine Resin Finishes

Paper read at European FATIPEC Congress, Lucerne.

Details were given by G. Widmer of the development of non-saturated melamine resins, which are capable both of polymerizing and of air-drying. These resins represent a new lacquer finish raw material. They may be regarded as a further technical development of the already known, allyl-melamine-ether. In addition to the allyl groups which dry by the absorption of atmospheric oxygen, they also contain co-polymerizable groups with styrol or other vinyl compounds.

Widmer gave details of the synthesis and structure of this new resin. It has been established that these new allyl-melamine ethers, particularly in the presence of cobalt driers, show a drying curve obtained with thin coatings and air exposure which is similar to that of linseed oil. Various drying curves were discussed in this connection and the through-drying of the finish in thin and thick coating applications, was discussed.

It was demonstrated that, by means of extensive research work in this field, it has been possible to obtain a lacquer system which through-hardens completely, within a short time. The through-hardening takes place simultaneously at the film surface by oxygen absorption, and in depth through the film by a polymerization at room temperature, which is initiated by peroxides.

The transparent and pigmented finish coatings are characterized by the following properties. An extremely hard film surface is obtained, with a very fine brilliance, and excellent resistance, not only to light and to weathering, but also to solvents, water,

spirits, and to dilute acids. The application of these finishes is similar to that of resins based on the polyesters.

Examples were given for the production of lacquers on the basis of the new-type product. The characteristics of the coatings obtained with these new finishes were discussed in full. Results obtained in short-term weathering exposure have been satisfactory.

The subject of lacquers without solvent medium was discussed. Up to now, a solvent-free lacquer has not yet been completely realized with the styrol-containing polymerization systems. The above work has served to show that, in the field of polymerization lacquers very considerable progress has been achieved from a qualitative standpoint.

Bright Rhodium Plating in Thick Coatings

R. Levy: *Werkstoffe und Korrosion*, **9**, #11, 686-689.

Decorative rhodium coatings are bright but no more than 1 micron in thickness. The thickness of industrial coatings vary from 2 to 25 microns, and are always mat. For certain purposes it is desirable to obtain thick and bright coatings.

The author accordingly tested the effect of various additions to the rhodium plating bath. It was found that the addition of certain metal salts delays the disappearance of the brightness with a thickness of up to 2 microns. The most outstanding brightening addition agents appear to be surface-reactive substances. A series of synthetic surface-reactive products, anionic, cationic, and non-ionic, were investigated. Some of these gave bright deposits with rhodium coating thicknesses which far exceeded 10 microns. The porosity of the coating and its surface tension, in addition, were considerably reduced and, through this, the corrosion resistance of the rhodium is definitely improved. The results obtained, however, are not absolutely constant and the investigation is being continued.

Corrosion-Resistant Steel Bolts by Chromizing Treatment

G. Becker: *Draht*, **9**, #1, 13-15.

Bolts made of non-alloy steel are coated with a surface layer by the indiffusion of chromium metal; this surface layer corresponds to the corrosion-resistant chromium steels. The corrosion-resistance of this surface zone is superior to other protective coatings normally applied. Chromium deposition by this process is achieved from gaseous chromium halides.

To obtain the best characteristics, the German IK steels, which have been specially developed for chromizing applications, are preferable. These steels, in combination with suitable after-treatment, give increased physical values, so that the application field is widened. The chromized steel bolts have already given satisfactory results in various fields of application.

Operation and Control of Hot-Dip Tin Baths

B. Keysselitz: *Feuerverzinnung Tagung* (Hot-Dip-Tinning Congress) Duesseldorf, November, 1958.

In hot-dip tinning, both with pure tin and with tin-lead alloys, impurities of varying types enter the bath. The solubility of copper and iron in tin-lead baths is so small, however, that no difficulties are presented.

When tinning with pure tin, iron separates out as $FeSn_2$ in the form of very small spherical crystals. As iron is practically insoluble in tin, this solution of the iron can only proceed in the secondary way by the somewhat acid fluxing medium, whose chief constituent is zinc chloride. Thus, the contamination by $FeSn_2$ occurs particularly in the pre-tinning kettle. On the basis of this knowledge, possibilities are presented with hot-dip tinning by means of which the formation of $FeSn_2$ can be held as low as possible by correct working procedure.

The iron impurities must be removed regularly by "cooking" with wood or potatoes. A much more uncertain way is blowing compressed air through the pot. In each case, no oxidation of the iron occurs, but an envelopment and a rising of the $FeSn_2$ crystals with a thin tin-oxide coating. Cleaning of the baths must be conducted at the lowest possible temperature — 240°C. Ladling-out the $FeSn_2$ crystals is not feasible, because of their smallness and the small difference in the specific gravity.

In tinning copper with pure tin, the high solubility of the copper in tin becomes noticeable, which greatly increases with rising temperature. Here, also, maintenance of temperatures which are as low as possible, is of importance. The compound Cu_6Sn_5, which separates out, consists of long, needle crystals, which interweave with one another very strongly and sink to the bottom of the kettle. In this way, they can be ladled out of the tin bath easily. On the basis of the presence of a eutectic with 0.7% copper, in practical operation, the copper content in the tin bath can hardly be brought below 1% by ladling. A complete removal of the copper from tin baths is possible by treatment with flowers of sulfur, by which the copper is converted to Cu_2S. The "Direct Chloride Process" has been developed, which works without a salt treatment and without acid pickling. Thorough blasting is required for satisfactory results, using a very fine steel shot. The shot-blasted parts are then immersed in the pre-tinning bath through a 5-8 cm. thick, strongly foaming flux-medium coating. The process is used for tinning cast iron. This activated fluxing medium causes a final cleaning of the cast iron surface. The process has the advantage of simplicity as no special equipment is required apart from that usually on hand. It is easily carried out and the results are uniform.

Anodizing and Coloring Aluminum for Architectural Applications

G. E. Gardam and A. W. Brace: Aluminium (Germany), **34**, #12, 702-709.

The authors in a previous section (**34**, #7, 392-97) first discussed the general conditions which have to be observed with respect to coating thickness, after-sealing, choice of metal, anodizing technique, and choice of dye. The present section covers the arrangement and layout of the anodizing plant, testing of the coatings and analysis of the materials and baths used.

Test Processes for Measurement of Elasticity of Organic Coating Films

N. A. Brunt: *Peintures-Pigments-Vernis*, **34**, #12, 566-74.

The experimental test methods are comprehensively surveyed. After a theoretical consideration, various test processes and apparatus are described for the examination and investigation of finish films. It is possible to present the results obtained with these test methods in a graphical form, by which the evaluation of the results is considerably facilitated. Diagramatic views of the test apparatus are shown.

Recent Developments

NEW METHODS, MATERIALS AND EQUIPMENT FOR THE METAL FINISHING INDUSTRIES

All-Purpose Liquid Cleaner

Turco Products, Inc., Dept. MF, 24600 S. Main St., Wilmington, Calif.

Plaudit, a multi-purpose liquid compound that can be used for almost any conceivable industrial cleaning operation, is currently being successfully used for such operations as steam cleaning, emulsion cleaning, immersion cleaning, ultrasonic cleaning and wipe-on cleaning, to name only a few.

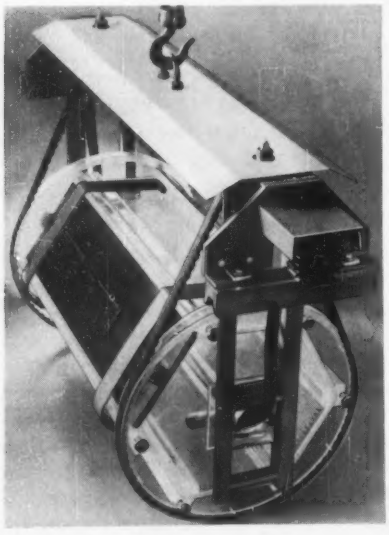
Mild and neutral, the product is safe on hands, painted surfaces, and other easily damaged surfaces, yet it is powerful enough to quickly and completely remove the heaviest soils, it is claimed.

Drip-Guard for Plating Barrel Superstructures

G. S. Equipment Co., Dept. MF, 15585 Brookpark Rd., Cleveland 35, Ohio.

Answering these dual needs of protection against corrosive drippage and color-code identification for plating barrel superstructures, is the new, low-cost "Drip-Guard."

Acting as a sheltering "roof" extending flush over the top of superstructure frame, the guard is shaped of lightweight sheet steel, and features a complete protective coating of new XL-12 Plastisol in any option of colors, including bright "safety-code" orange.



The coating is impervious to corrosive solutions, and can easily be wiped clean even after extensive use under most severe conditions. Easily, quickly attached to pick-up bale bolts, no other fasteners are required. Models are available to fit all makes, sizes, types of barrel superstructures.

Vinyl Glove

Surety Rubber Co., Dept. MF, Carrollton, Ohio.

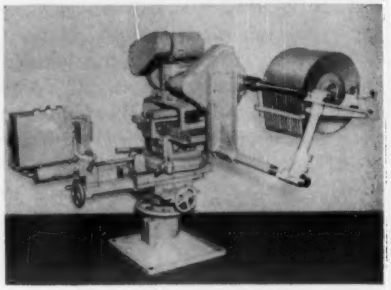
Four-To-One gloves are claimed to outwear cotton and many types of leather gloves by four or more to one. Styled for soft flexing hand comfort and positive gripping action, the vinyl impregnated gloves are extremely abrasion and snag resistant. They are also easily laundered to keep them clean and new looking for the life of the glove.

The gloves are available in both men and women's medium and large sizes and either slip-on or gauntlet styles.

Automatic Buffing Machine

Acme Mfg. Co., Dept. MF, 1400 E. Nine Mile Rd., Detroit 20, Mich.

A new oscillating arm-type machine provides a method for automatically buffing or polishing a wide variety of parts which have obstructions that prevent complete rotation. The machine is ideally adapted to the buffing of parts such as coffee pots with spouts or ratchet-type wrench heads with handles that prevent complete rotation of the part in contact with the buffing wheel. Other types of parts with handles, large butt hinges, plumbing and boat hardware parts with one side obstructed, or stampings or die castings with radius portions that require buffing can also be finished on the machine.



Basically, the machine consists of an E-10 semi-automatic machine equipped with an air cylinder advance and an oscillating arm fixture. Parts can be mounted on an arbor with a locator and square drive. Then the arbor and part assembly are positioned in the oscillating-arm unit by an air-powered tailstock. Other special types of part chucking arrangements can be provided to suit the part requirements.

With the parts positioned in the arm, they are advanced by an air cylinder control into contact with a buffing wheel mounted on a conventional double-end buffing lathe or an adjustable lathe. Then a pushbutton initiates a timed sequence of arm oscillation to give the desired contact time. The oscillating arm unit can be adjusted to give from zero to 360-degrees of oscillation and thus meets a variety of part finishing requirements.

The machine, equipped with the oscillating arm and air actuated devices, occupies a floor space approximately 4-ft. by 5-ft. and is 4½ ft. high. The arm is powered with a ½-hp motor.

Control Valve

Graver Water Conditioning Co., Dept. MF, 216 W. 14th St., New York 11, N. Y.

A patented single control valve for

ROUND SHAPES
SQUARE SHAPES
ODD SHAPES

all plate brighter with new, improved

COPPER-LUME

Whatever the shape of *your* products, give them a brilliant, uniform copper finish with COPPER-LUME, the new, improved bright cyanide copper process by H-VW-M. *Fights corrosion—lasts longer.* The uniformly bright COPPER-LUME deposit is an ideal base for subsequent nickel-chromium deposits. And where buffing is required, COPPER-LUME buffs to *maximum* brightness in *minimum* time. Write for more details about better, brighter copper plating, the new COPPER-LUME way.

Hanson-Van Winkle-Munning Company, Matawan, New Jersey.
Offices in Principal Cities.
Alert Supply Company is H-VW-M in the West
Los Angeles • San Francisco

H-VW-M
Progress in metalfinishing through advanced process • equipment

COPPER-LUME — U. S. Patents 2881121, 2881122

at Nichols Industries, Inc.

Stokes Vacuum Metallizers help toy maker capture new markets

Aluminizing metal parts of toy pistols and rifles has paid off handsomely for Nichols Industries, Inc., Jacksonville, Texas. Now one of the world's largest toy gun manufacturers, Nichols credits its four 48-inch Stokes Vacuum Metallizers with a big assist in speeding production and cutting costs, enabling the company to introduce new low-price items and become a leader in this competitive market.

Nichols operates its Stokes metallizers around the clock, aluminizing zinc castings one to twenty inches in length. Vacuum metallized parts have a more brilliant finish than the previously electroplated items, and production time and labor are far less. The dependability, ease of operation and low maintenance of the Stokes units help keep costs low.

Vacuum metallizing offers attractive opportunities for many products made from many materials . . . including metal, plastic, glass, paper and textiles. And Stokes design and operating features assure you the full benefits of the process. Stokes offers valuable aid in planning your vacuum metallizing facilities . . . selecting the correct equipment . . . training operators. Contact your nearest Stokes office for a discussion of your requirements, or write for data on Stokes Vacuum Metallizers.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Phila. 20, Pa.

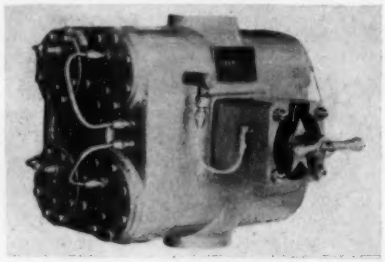
STOKES

directing the flow of liquids in zeolite softeners, ion exchange units and filters, called the Monotrol, is designed to perform the functions of a nest of individual valves while providing greater ease in operation and maintenance. It is available in cast iron or in acrylic plastic for corrosive service, and can be operated manually or automatically.

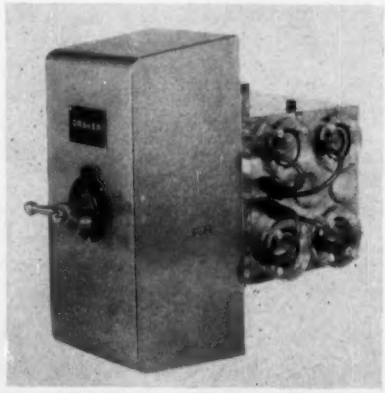
Features of the valve include pilot control, positive hydraulic pressure actuation and easy maintenance. All internal moving parts can be removed readily for inspection and service without dismantling the connecting piping or removing the valve from the unit on which it is being used. In addition, the design provides for low pressure loss during operation and no contamination of effluent with influent.

When the pilot is set, hydraulic pressure acts to move the pistons which open and close ports in the valve body, thus allowing liquid to flow through the proper channels and accomplish the required operation. The pistons direct the flow of four basic functions: service, backwash, regeneration and rinse (with the regeneration step omitted in filter applications). Upstream line pressure is all that is required to actuate the pistons.

The control is shop assembled, tested and shipped with the manual or automatic pilot valve mounted, so that it



Cast Iron Unit with Manual Pilot.



Plastic Unit with Automatic Pilot.

can be immediately connected to the unit on which it is to be used. Conversion from manual to automatic operation can be made easily in the field.

Bright Nickel Process

Hanson-Van Winkle-Munning Co., Dept. MF, Church St., Matawan, N. J.

Superlume, according to the manufacturer, gives the brightest, smoothest nickel deposit obtainable today. It is claimed to yield deposits which are exceptionally bright at high and low current density areas and has the ability to level-out scratches to an extraordinary degree.

The process is also characterized by an excellent tolerance to inorganic impurities such as zinc and copper and the bath is amenable to continuous carbon treatment resulting in relative freedom from organic contamination.

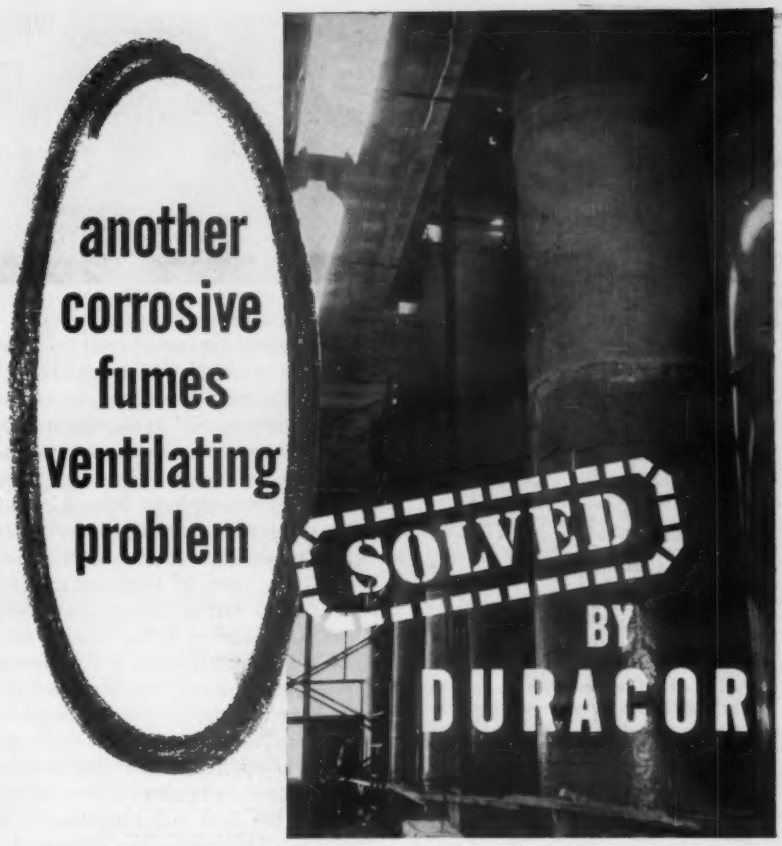
After original make up, only two addition agents are used. One provides ductility, stress relief and tolerance to impurities. The second addition agent provides high brightness and leveling. Conversion of existing baths to the new process is relatively easy. A gallon sample of existing baths should be sent to the firm's laboratory for exact conversion instructions.

Agitation has a beneficial effect in producing bright, smooth, uniform deposits. Means of agitation may be provided by conveyor motion, mechanical agitation, cathode rocker or air agitation. The latter is preferred because it makes for greater deposit uniformity. A still bath variation is available.

Roller Coater

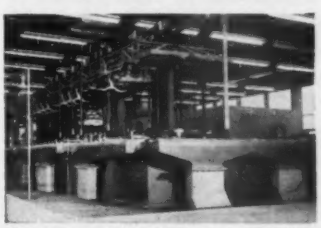
Murray-Way Corp., Dept. MF, P. O. Box 180, Birmingham, Mich.

A new roller coater, Model CG, is specially designed for easy cleaning and for use with materials or com-

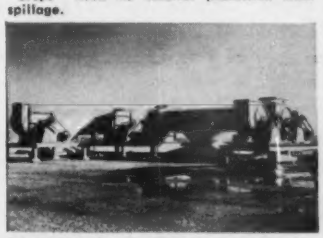


Duracor Ventilation System exhausts 250,000 C.F.M. of corrosive fumes from large electronic equipment plant.

Strong, lightweight DURACOR ducts over 5 feet in diameter require minimum support.



Corrosion-proof throughout, these DURACOR "drops" need no exterior protection from spillage.



Weather and corrosion resistance are provided by DURACOR "T" sections on roof.

PROBLEM: This ventilating system had to withstand sulphuric, nitric, chromic, phosphoric acid and cyanide fumes emitted from the plant's plating and anodizing operation.

SOLUTION: Working from customer specifications, Ceilcote engineers built the entire ventilating system shown here completely from DURACOR.

INSTALLATION: Experienced Ceilcote supervisors and crews handled the complete installation under one contract. Materials and workmanship are fully guaranteed.

WHAT'S YOUR PROBLEM? . . . DURACOR resists any corrosive gas, fume or liquid . . . can be fabricated to virtually any shape. Write today and tell us about your requirements.

DURACOR CEILCOTE

THE CEILCOTE COMPANY, INC.

4844 Ridge Road • Cleveland 9, Ohio

IF IT'S COLOR YOU WANT

use

Luster-on®

Chromates on Zinc

Now . . . at a low, low cost . . . you can get brilliantly bright and sparkling colors from an improved Luster-On Chromate dip process for your zinc-plated small parts.

And . . . even more important . . . these are not just dull identification colors. They are glamorous and sales-building golds, yellows, blues, reds, greens, violets, brass and copper hues.

Write today for the full story on revolutionary LUSTER-ON COLOR. Sample gladly processed free.

Use **STRIPODE**

the proved addition agent

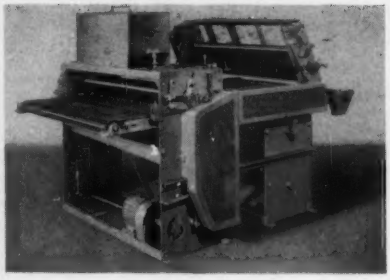
- to strip nickel plate faster.
- to protect the base metal from pitting, roughening and etching.
- to save on use of acid.
- to eliminate need of sand blasting or heavy buffing.

Order a trial gallon

The Chemical Corporation

58 Waltham Ave. • Springfield 9, Mass.

West Coast: Crown Chem. & Engr., Los Angeles & San Francisco
Canadian Licensee: Alloycraft Ltd., Montreal



pounds of high viscosity.

The upper applicator roll of this new roller coater is hinge-mounted so that it may easily be opened for cleaning. Another special feature is a new method of applying materials or compounds to the rolls by "ironing" them onto the applicator roll. Materials and compounds which formerly could not be applied by rolls may now be roller coated, for "ironing" them reduces the problems of stringy compounds and eliminates foaming. Better coating surfaces are thus attainable, it is claimed.

When extra heavy coatings are required, or when a conditioner must be applied to the work before the final coating is applied, the roller coaters may be used in tandem. The work is fed into the first roller coater by a conveyor. The conveyor between the first and second roller coaters feeds the work into the second unit and provides a "setting time" for the first coat before application of the second coat.

The new roller coaters are available in various widths, with vari-drive and explosion-proof controls.

Duplex Nickel Process

Udylite Corp., Dept. MF, Detroit 11, Mich.

A new process of plating two layers of nickel under a chrome finish, used on steel and on copper-plated zinc-base die castings and registered under the name "Bi/Nickel," solves the problem of adhesion between nickel layers, according to the manufacturer.

Using any of several combinations of semi-bright and fully bright plating processes, the system first coats the basis metal with a heavy layer of semi-bright nickel. A layer of bright nickel is then applied, and finally, chromium.

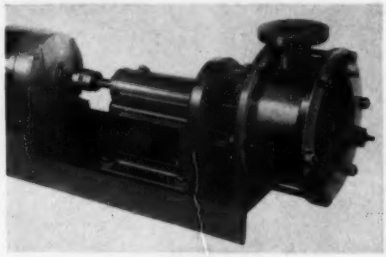
In addition to long service life based on superior corrosion resistance and its production advantages, the process produces an electroplated finish of excellent color and finish, it is stated.

Use of particular combinations of semi-bright and bright nickel, and varying thicknesses of the coatings, company representatives explain, is determined by the specific requirements of individual applications. To evaluate such requirements and assist platers with uses of the new process, the firm also announced the availability of a special technical task force to work on customer projects.

Plastic Centrifugal Pumps

Vanton Pump & Equip. Corp., Dept. MF, Hillside, N. J.

Two polypropylene centrifugal pumps, which possess excellent resistance to solvents, greases, oils and many common acids and chemicals at high temperature, are available in two sizes, offering a capacity range of from 2 to 80 gpm. Model #ZP-25 has a 2-30 gpm capacity and model #ZP-35 an 8-80 gpm capacity. Pumps can handle solution temperatures up to 300° F.



The light weight, high strength, rigid, mar resistant polypropylene casing is totally protected by a cast iron frame which gives added support. The molded impellers are of a dynamically balanced design. All pumps are equipped with mechanical shaft seals of the latest design in a range of materials to cover virtually all corrosive applications.

Pumped fluid contacts only the facings of rotating and stationary rings which can be provided in either Teflon, carbon, ceramic or Stellite material. Stationary rings can be reversed for additional use after long periods of service.

Easy maintenance is another feature of these new pumps. By removing six bolts, casings may be inspected or replaced without disassembly of the whole pump. The heavy duty stainless steel shaft with a polypropylene cover on the wetted end can be removed from the pump in either direction. No special tools are removed to dis-assemble the pump which does not have to be removed from base and motor.

Low friction, widely spaced roller bearings are used in the bearing pedestal to give quiet operation and to reduce loading.

Zinc Bath Brighteners

Allied Research Prods., Inc., Dept. MF, 4004 E. Monument St., Baltimore 5, Md.

Two new brightening agents for zinc plating, named Isobrite #354 and #355, are supplied in liquid form in either 5 gallon lined pails or Auto-Flo-Pak container. They are extremely stable, providing effective brightening even after weekend shutdowns. Liquid form eliminates mixing, and simplifies control. They will tolerate wide variations in zinc bath formula. Both have been extensively tested in actual field use with satisfactory results.

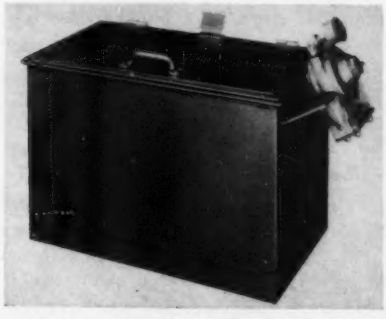
#354 produces a white, bright plate directly from the barrel even without bright dipping. This liquid brightener is the first to match the powder compounds in efficiency and economy.

#355 produces a bright zinc deposit with a slight yellow cast from barrels, or rack plating tanks. However, its fine grain, uniform deposit produces a plate with clarity and sparkle after bright dipping. It provides true economy of operation, with long life and performance over a wide range of conditions, it is claimed.

Mask Washing Machine

Conforming Matrix Corp., Dept. MF, 349 Toledo Factories Bldg., Toledo 2, Ohio.

Model W-1500-S is a small portable mechanical machine which effectively



washes masks up to 10" x 10" in a matter of seconds, cleaning them by violent agitation of the solvent. Motivation is by an air motor requiring from 2 to 7 c.f.m. The solvent tank has a capacity of approximately 7 gallons.

The washer is of sturdy steel construction and is designed with an inner tank having a heavy screen bottom which permits the settling out of solids. It is easily removed from the outer shell for cleaning.

Installation is made by simply connecting a ¼" air hose to the motor.

Aluminum Etchant

Metal Processing Dept., Pennsalt Chemicals Corp., Dept. MF, 3 Penn Center, Philadelphia 2, Pa.

A new aluminum etchant in solid form, called AE-16S, is an improvement over the manufacturer's widely-used aluminum etchant AE-16 in flake form. The new product is dustless, gives off no heat of solution, is easier to handle, and is lower in cost. It is packed in 90-lb. net light metal containers that open with hand tools, or with a key available. The solid block can be removed from the container and put into solution in minutes. The compound goes into solution quickly with a minimum of agitation.

Dry Acid Powder

Heatbath Corp., Dept. MF, Springfield 1, Mass.

Aricid B is a completely water soluble dry acid powder consisting of a mixture of acid salts, activators, corrosion inhibitors and surface active agents, for use as a replacement for liquid acids, especially muriatic and sulfuric.

Solutions are made by dissolving from 1 ounce to 3 pounds of salts per gallon of water, depending on the application. They are used as activating dips on steel, brass, copper and zinc die castings, prior to plating, phosphating and black oxide. They are also used for removing rust, heat treat scale, oxides, soldering flux and as a chromium plate stripper.

Sonic Energy Cleaning Systems

Bendix Aviation Corp., Pioneer-Central Div., Dept. MF, Davenport, Iowa.

Greater cleaning efficiency and substantial price reductions feature these newly revised sonic energy cleaning systems. Technological advancements in the new cleaner models permit the use of substantially smaller electronic generators and provide improved levels

WHY GUESS?

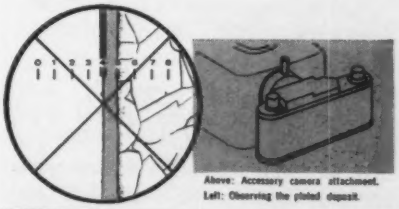
MEASURE PLATING THICKNESS

to a millionth of an inch

Your profits depend on meeting tight specifications, maintaining quality control and reducing rejects. Can you afford to guess at plating thickness when it is so easy to measure and be sure?

UNITRON'S PL-MEC PLATER'S MICROSCOPE substitutes facts for uncertainty. The plated deposit is observed through a Filar Micrometer Eyepiece and measurements are read directly from a micrometer drum. This compact microscope is easy to use, portable around the shop and has a built-in light source. It also doubles as a metallurgical microscope for examining grain structure etc. at magnifications of 25X-1500X. Permanent photographic records may be made using an accessory 35mm. camera attachment and provide valuable legal protection for subcontractors.

UNITRON'S PLATER'S MICROSCOPE will save its initial cost many times over. Prove this for yourself — as so many firms in the plating industry have done—by requesting a **FREE 10 DAY TRIAL** in your own plant. There is no cost and no obligation.



Above: Accessory camera attachment.
Left: Observing the plated deposit.

$468 Model PL-MEC complete with all optics and standard accessories	As above with built-in camera attachment, but without 35mm. camera back: **$540**

THE TREND IS TO UNITRON

UNITRON

INSTRUMENT DIVISION OF UNITED SCIENTIFIC CO.
204-206 MILK STREET, BOSTON 9, MASS.

Please rush UNITRON's Microscope Catalog 13-Y

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Company_____

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of sonic energy cleaning efficiency, while precluding noise and transducer cooling problems. Improvements in both the generator and cleaner will also actually extend the extremely long life and high reliability characteristics of the magnetostrictive transducer equipment.

The new cleaners are accompanied by new coordinated units for rinsing, drying and filtering. Refinements in these units have been made for additional operating efficiency and freedom from maintenance.

Nickel Anodes

Hanson-Van Winkle-Munning Co., Dept. MF, Church St., Matawan, N. J.

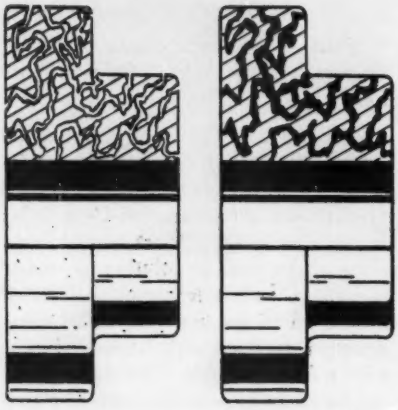
A new-shape nickel anode is claimed to feature less proportionate scrap loss per anode and longer runs between replacement periods. The new shape anode is called Econ-O-Shape by the company and will be marketed in a new type anode shipping container. The container, made of heavy pasteboard, is oil and water resistant and holds the anodes firmly in place during shipment, no matter how rough the handling. Labels affixed to either end of the container show number of anodes contained and their weight.

The anodes are made from highest purity metal, produced under the strictest metallurgical control, insuring correct melting and pouring temperatures and rate of cooling—all important factors affecting anode structure and performance.

Sealer for Powdered Metal Parts

National Sinter-Seal Co., Dept. MF, Seneca Industrial Center, Buffalo 10, N. Y.

Sinter-Seal is a specially compounded thermo-setting plastic resin which is impregnated into the pores of sintered metal parts. The treated parts are then cured under controlled temperatures until the plastic is an inert, permanently hard mass which renders them completely pressure-tight and non-absorbent. The sealer does not alter the appearance or dimensions in any way; is not effected by intermittent temperatures up to 350°-400° F. range; plating solutions, moisture, oil and most solvents will not penetrate the cured resin. Because the pores are completely filled, internal electrolytic and chemical corrosion and bacterial contamination is prevented. Generally, the design, size or type of metal does not decrease the effectiveness of the process. A representative sample of parts are tested and a full written report is issued with each order. Samples for test purposes will be processed at no charge.

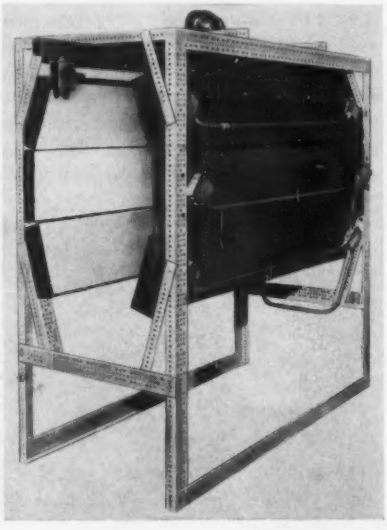


BEFORE & AFTER
THE USE OF SINTER-SEAL

Infra Red Heating Ovens

Infra Red Systems, Inc., Dept. MF, 240 Route 23, Riverdale, N. J.

Modular infra-red ovens can be made to fit any drying system, give uniform heat over entire emitting area; and can be used with any conveyor. The basic module of these ovens is called Redi-Ray, a completely self-contained heater which uses a ceramic face as a source of infra red radiation. The ceramic face is brought up to emission temperature by the formed resistance wire embedded in an insulating block back of it. The entire heating block is backed up by alternate layers of batt and reflective insulation. All are mounted in a sheet metal shell of modular dimensions.



A novel design feature of the oven allows radiant energy which does not strike the work to be absorbed by the module directly opposite and, thereby, reduce the power necessary to maintain proper radiation temperature. This regenerative principle has resulted in exceptionally high efficiency.

Temperature control is accomplished by any adequate voltage control. The unit shown gives up to 500 watts per sq. ft. radiation. Work temperatures go up to 400° F. Other units available go up to 2000 watts per sq. ft. The 6-foot oven shown is a basic modular length. Another 6-foot section can easily be added to double production. Other configurations of almost any length and module arrangement could be supplied at reasonable cost. These units are competitively priced with other ovens on the market.

Bronzeless Gold Coatings

Bee Chem. Co., Logo Div., Dept. MF, 12933 S. Stony Island Ave., Chicago 33, Ill.

Bronzeless Golds are available in standard and matched metallic shades which eliminate antiquated and costly methods of mixing bronze powders. They are supplied ready-mixed (just add thinner). The old problems of poor shelf life (gelling) and settling during production (poor coverage and color change) are completely avoided, it is claimed. High bake temperatures can be used without apparent color change and exceptional mileage shows a substantial saving in cost per piece part.

Although protective top coats may be used, the Bronzeless Golds offer excellent protection against perspiration, humidity and salt spray, "rub off" and "flaking," without the use of clear lacquer. When applied over a designated surface as directed, they provide "Scotch Tape" adhesion and will also pass a 3H pencil hardness and adhesion test. They offer a harder, non-brittle surface with exceptional durability and color stability.

Solvent-Detergent

Tect, Inc., Dept. MF, Northvale, N. J.

Teclene #135 is a new solvent-detergent of exceedingly high penetrating and emulsifying action, modified with chlorinated solvents of low volatility to remove heavy oil, grease and other contaminants. It may be brushed or sprayed on the surface, then rinsed

NOW...

your UDYLITE nickel brighteners come in this new RIP-OPEN PACKAGE for greater speed and SAFETY!

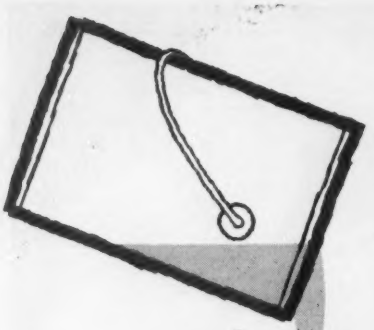
This new Udylite carton provides you with a handy replaceable lid that fits snugly back on the box to keep out dirt and protect the remaining bottles.

This new Rip-Open packaging, just introduced by Udylite, is typical of the attention we feel is due small details. Speedy and easy is the opening job when, with a roundhouse *rip* of the tear-off strip, your carton of Udylite brightener containers is open . . . neatly and evenly.

Here is one more example of why it pays to deal with Udylite—where you can be sure of getting first rate plating supplies of a quality and price that you know you can depend upon. And always at Udylite you find the respect for fine points of performance that makes this the finest plating supply service. If Udylite isn't already your source, investigate now the advantages of dealing with

the udylite corporation

detroit 11, michigan
world's largest plating supplier



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with either water, steam or solvents. The addition of three parts of water to seven parts of solvent forms a gel which may be applied with brushes to vertical surfaces, yet is easily rinsed with water.

The product is a golden yellow liquid of the viscosity of light oil. It has no flash point and is of low toxicity, due in part to the slow evaporation rate of the material. Although alkaline, it may be used in the cleaning of all metals and will not attack aluminum. Samples are available from the producer.

Fume and Mist Suppresant

Allied Research Products, Inc., Dept. MF, 4004 E. Monument St., Baltimore 5, Md.

A new fume and mist suppressant for use in chromium plating, anodizing, bright dipping, and other metal finishing processes where gas generation is a problem, #21 Mistex acts to form a thin foam blanket on the surface of the process solution. This blanket reduces fuming by trapping gas bubbles as they rise from the solution and absorbing both the gas and the vapor in the bubbles. It also appreciably reduces solution loss from mist or spray and, further, reduces drag out as work is removed from the bath. Substantial heat savings are also realized by the reduced need for ventilation. The compound is formulated to provide the foaming action without interfering with either the action or the balance of the bath on which it is used.

The product is supplied in concentrated liquid form and is diluted with water in ratios varying from 3 to 20 parts before adding to the bath. Precise dilution depends upon the conditions under which it is to be used. The only control required is a visual inspection to make sure the foam blanket is maintained at a uniform and consistent thickness of approximately one-half an inch.

Cleaner and Brightener for Aluminum

Clarkson Labs., Inc., Dept. MF, 930 N. Darien St., Philadelphia 23, Pa.

A new formulation which cleans and brightens aluminum in one application, Clarco 2200 is designed specifically for ease of application and efficiency of removal of the oxide film.

It is applied by brush, allowed to dry for one to two minutes, and rinsed off with water.

Aluminum Deoxidizer

Chemclean Products Corp., Dept. MF, 15-08 121 St., College Point 56, N. Y.

Oxide, scale and heat discoloration are removed from aluminum by a one-step method with Ox-Off #536, it is claimed. The procedure may be used to clean aluminum before welding, to remove discoloration after welding, soldering, or heat treating, and to level off minor scratches and mars.

The new procedure is believed to be the only method of removing oxide in one step by hand-wiping or dip-tank operation with a ready-made solution, followed by water rinse, all at room temperature.

BUSINESS ITEMS

Sax of American Buff Buys J. J. Siefen

Purchase of the *J. J. Siefen Co.* of Detroit was announced by *Ben P. Sax*, chairman of the board of the *American Buff Co.*, Chicago, manufacturer of buffs and polishing wheels.

Siefen manufactures buffing compounds and spray equipment for the metal finishing industry. Established in 1927 by *J. J. Siefen*, this company originated a system of spray equipment and liquid compounds. The company also originated cements for polishing in the metal industry.

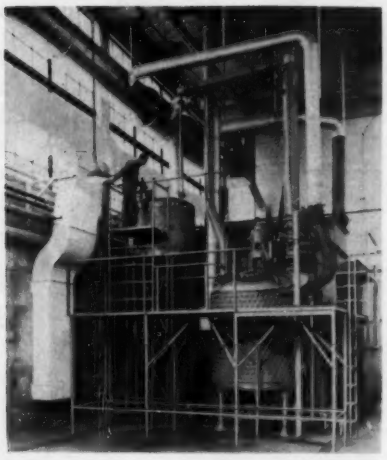
J. J. Siefen Co. will retain its separate identity and will continue to operate as a separate enterprise. The company also has offices in Chicago; Cleve-

Ben P. Sax

land; Los Angeles; Syracuse, New York; Beloit, Wis.; Flint, Mich.; and Hamden, Conn.

Mr. Sax bought the Detroit company from *Mrs. Ida Siefen Stark*, widow of its founder. Mrs. Stark has expressed satisfaction that the business will continue to be operated by an old friend in the industry of nearly 30 years.

Udylite Opens Plant on Fortieth Birthday



Forty years of business and thirty-two years of operating in the state of Michigan were completed recently by the *Udylite Corp.*, world's largest electroplating supplier. The anniversary was celebrated with the official announcement of new $600,000 facilities for manufacture of organic chemicals at its subsidiary, the *Udylite Research Corp*, 21441 Hoover Road, in Warren, Mich., a suburb of Detroit.

The new facilities include a physical addition of 20,000 square feet of plant space, which brings the total research plant area to more than 50,000 square feet. Adjacent manufacturing facilities total 185,000 square feet.

Safety facilities in the fireproof, reinforced concrete building include explosion-proof electrical equipment and readily accessible showers. To maintain good operating and working conditions, an air exhaust system changes the air in the entire processing area fifteen times an hour.

In addition, the processing flow has been planned for minimum handling. Product-approved lined tanks, reactors and pipes carry the finished chemicals from storage tanks to a 10,000-lb. truck scale at the fill station. Here shipping containers can be loaded accurately and removed by fork lift trucks.

For Catalytically Accelerated, Controlled

ETCHING OF ALUMINUM

Use **KELITE ALSITE**

The desirable properties of an aluminum etchant are:

1. To impart a surface which will hide die marks and imperfections.
2. To impart a surface which is aesthetically pleasing.
3. To etch at a catalytically accelerated rate.
4. To etch uniformly.
5. To remove light oils and other moderate soils.
6. To provide foam and fume control.
7. To prevent scaling, even after prolonged use.
8. To permit quick and accurate solution control.
9. To be economical.

Kelite Alsite does all this. Additionally, Kelite offers Alsite CX, a concentrate additive for caustic soda.
Kelite Alsite and Alsite CX are protected by U.S.Patent No. 2,853,372.

For further information or a product bulletin, contact the nearest factory office below.

KELITE CORPORATION
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A heated roadway was also completed at the time of the addition to keep the path between the research center and the manufacturing plant free of snow and ice.

Carborundum Promotes Watson

Gordon O. Watson, formerly assistant director of marketing for *Carborundum Co.'s* midwestern sales district, has been promoted to assistant director of marketing for the company.

Experienced in all phases of abrasives sales, Mr. Watson started with the firm in 1925 as a billing clerk and has progressed through sales promotion, direct selling, and district sales management. In his new position, Mr. Watson will give special attention to the development, coordination, and implementation of an expanded program for marketing abrasives manufactured by the company's Electro Minerals, Bonded Abrasives, and Coated Abrasives Divisions.

Sel-Rex Buys Meaker Co.

The Meaker Co., Chicago, Ill., pioneer manufacturer of automatic systems for continuous and batch metal processing or finishing since 1899, has been purchased by *Sel-Rex Corp.*, and will operate as a wholly-owned subsidiary under the general supervision of its present staff.

Meaker facilities for manufacturing, engineering, sales and service will be expanded to diversify current product lines, as well as to intensify marketing

Morris M. Messing

operations of its automatic equipment. Present distributor-franchises will be renewed, and several new resident sales and service engineers will be appointed shortly to provide more concentrated coverage for the entire country.

With the acquisition of Meaker and the greatly expanded and varied line of products for metal finishing and processing, Sel-Rex is expected to play an even more important role in the industries it serves.

Officers and executive personnel of Meaker, as reorganized, will be: *Morris M. Messing*, president; *Victor Finston*, executive vice president and general manager; *Alexander Wright*, administrative vice president; and *Lucien R. Collart*, secretary-treasurer.

Jerome L. Ross, formerly manager of Sel-Rex's Equipment Div., has been appointed assistant general manager and will make his headquarters at the Meaker offices at 1629-41 S. 55th Ave., in Chicago, where he will share the responsibility of engineering, manufacturing and sales with Mr. Finston, who had been president of Meaker for many years.

Jerome L. Ross

A Chemical Engineering graduate of Columbia University, Mr. Ross was previously associated with DuPont in sales, research and technical service, with the Carlton-Cooke Plating Co. as plant superintendent, with Century Plating and Engineering as plant manager, and with North American Aviation as superintendent of finishing.

Peter Arnold, formerly development engineer for automatic equipment with Hanson-Van Winkle-Munning Co., has been appointed eastern sales manager for equipment of Meaker. He will make his headquarters at Sel-Rex's executive offices in Nutley, N. J., in order to be closer to his area of responsibility.

Peter Arnold

A Mechanical Engineering graduate of the University of Virginia, Mr. Arnold has patented several inventions for automatic load and unload machines and continuous conveyor-type equipment for electroplating, metal finishing and processing. He will be responsible, in his new post, for maintenance of dealer and distributor liaison and for the technical training of sales and service personnel on Meaker equipment.

Mr. Arnold, who resides in Elberon, N. J., is a member of the American Society of Tool Engineers and the American Chemical Society.

Hubbard-Hall Appoints Wilmot

Hubbard-Hall Chem. Co. of Waterbury, Conn. has announced the promotion of *Stanley P. Wilmot* to the newly-created position of operations manager —Waterbury plants. In his new position, Mr. Wilmot will co-ordinate the activities of all non-office personnel and have over-all supervision of warehousing, manufacturing, delivery, and maintenance activities.

Mr. Wilmot has been with the organization for 15 years. He started as foreman of manufacturing operations and later became chemical buyer in the heavy chemical department. Mr. Wilmot was then appointed superintendent of Connecticut Chlorine Products, a wholly owned subsidiary, a position he held until his new appointment.

U. S. Stoneware Appoints Davis

U. S. Stoneware Co., Akron, Ohio has announced the appointment of *Shelby A. Davis* as sales manager of its Coatings Division and also of the Coatings Division of its affiliated company, Chamberlain Engineering Corp. In his new position Davis will direct the sales of the two firms' lines of corrosion-resistant paints, plastisols and dipped items.

Shelby A. Davis

Davis has been a member of the firm's sales department since 1955 and has acquired a broad experience in corrosion- resistant products and materials of all types. For five years previously, he was with the W. J. Ruscoe Co. selling coatings and adhesives.

A graduate of Akron University, Davis is married, the father of two sons and lives in Cuyahoga Falls, Ohio.

Belke Appoints Bill Sticksel

Belke Mfg. Co. announces appointment of *William K. Sticksel* as sales engineer for their extensive line of plating equipment and supplies. His

William K. Sticksel

headquarters will be at the plant in Chicago.

Mr. Sticksel is a class 1945 graduate of Michigan State College where he majored in chemical engineering. He had been active in sales and service to the plating industry with concerns like Udylite and Diversey Corp. prior to joining Belke.

Lane Named General Manager of Graver

Marvin Lane, technical director of *Graver Water Conditioning Co.*, New York, a division of Union Tank Car Co., has been named general manager of that division. He succeeds *H. T. Sulcer*, who recently resigned.

Mr. Lane received his B.S. degree in chemistry, cum laude, in 1940. Shortly after he began graduate work at the University of Pennsylvania, he was called to engage in vital war projects. During the war, Mr. Lane participated in development of desalting kits for downed airmen and castaways; desiccants to protect materials during storage; and oil removal filters for Liberty ships. He took part in research to find new ion exchange resins to broaden the use of ion exchange in purifying process liquors. He was awarded the Certificate of Merit, a government citation, for his services.

Marvin Lane

Prior to joining the firm in 1949, Mr. Lane was instrumental in developing synthetic U.S.P. quality water through silica removal by ion exchange and conducted the first field tests on commercial equipment for this purpose.

The new general manager, who was born in Philadelphia and now resides in Cranford, N. J., is a frequent speaker at technical meetings and is the author of numerous papers. Among the professional societies to which he belongs are the American Chemical Society and the American Society for Testing Materials.

New Magnus Directors Named

Three new directors were elected at the recent annual board meeting of the *Magnus Chemical Co., Inc.* Those elected were: *Richard P. Edmonds* of 14 Cypress Terrace, Springfield, N. J.; *Leon Salz*, 1175 Foothill Way, Mountainside, N. J. and *P. Edward Gabelmann* of 2030 Wood Road, Scotch Plains, N. J.

Mr. Edmonds joined the firm in 1952 and, at that time, founded the

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it's the "HOW" *and* "WHERE" *it's done*
that counts

–a message of importance from . . . DuBois Chemicals

Take paint stripping, spray booth cleaning, phosphatizing or metal cleaning. For A-1 results, you can't cut short on good, chemical ingredients.
The materials that go into DuBois cleaners and detergents are the finest. But, the application on the job requires the experience of the DuBois tech-service man. With DuBois products, he can show you that *dollar, time and labor saving* are not empty words. *Cleaning is 95% labor—5% compound costs.* When you use DuBois' program of superior compounds, combined with helpful service you save where it costs most—labor!
Our representative and tech man will show you how this is done. Write the DuBois Co., Inc., Cincinnati 3, Ohio, or call our man listed in the Yellow Pages under "Cleaning Compounds". Your metal cleaning or plant maintenance problem is probably one he has solved many times.

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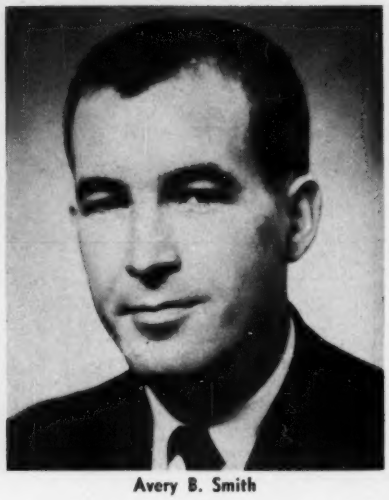
Plants in: Cincinnati • Los Angeles • Dallas • E. Rutherford, N. J.
Representatives and Warehouses throughout the United States, in Canada and parts of Latin America

Richard P. Edmonds

P. Edward Gabelmann



Avery B. Smith

Finishes and Coatings Division which he manages. He graduated from the University of Chicago in 1936 with a B.A. degree and credits for two years of graduate work in educational psychology and literature. He worked on the editorial staffs of several magazines as well as in advertising until 1939. Then he became associated with the paint manufacturing industry in the Chicago area.

Mr. Salz graduated with a B.A. degree from New York University and subsequently earned a M.S. degree in chemistry from the University of Michigan.

Mr. Salz joined the Crane Packing Co. in Chicago for two years and then went with Mobil Oil Laboratories. He became a senior chemist at Mobil working on drawing and cutting oil formulations. In 1950 he joined Magnus as manager of the Lubricants Division.

Mr. Gabelmann, who has been with the firm eighteen years, attended Newark public schools and New York University. After graduating with a Mechanical Engineering degree he was associated with the Carrier Corp. He is at present manager of production and purchasing for the Equipment Division.

Enthone Promotes Equipment Departmental Personnel

Enthone, Inc. of New Haven, Conn., has expanded its organization for the manufacture and distribution of metal finishing equipment and has announced the following promotions from within its equipment department: *Kenneth D. Miller* to chief engineer; *Avery B. Smith* to supervisor of equipment operations; *Joel R. Field* to technical representative-racks; and *George S. Rudoff* to shop foreman.

Mr. Miller will direct the engineering, design and manufacturing facilities of the equipment department and, in addition, will serve as plant engineer. He joined the firm in August, 1958 as design engineer and previously was a group engineer in the continuous equipment department of Hanson-Van Winkle-Munning Co. He is a member of the National Association of Power Engineers.

Mr. Smith will be in charge of production control and liaison with company sales engineers and customers. He has been employed by Enthone since June, 1957 in a supervisory capacity and is presently completing the requirements for a degree in industrial management at New Haven College.

Mr. Field will render technical service to customers on their plating rack requirements and will assist them with rack design. He has had eight years experience in directing rack design and

Leon Salz

Kenneth D. Miller

Joel R. Field

George S. Rudoff

manufacture for the rack division of the firm's equipment department.

Mr. Rudoff will be responsible for direct supervision of the manufacturing facilities of the equipment shop. He previously held a similar position in the plastic division of the department.

New Staff at American Chemical & Refining

A re-alignment of the management staff of *American Chemical & Refining Co., Inc.* has been announced recently. *George Dietz, Jr.* has been named executive vice president and general manager assuming management of all phases of company operation. He will report directly to the president. *Quentin A. Dietz* has been elected vice president & general sales manager to head up the new marketing and sales program. *Newell W. Mitchell* has been named director of research

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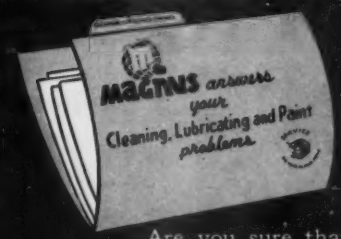

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Albert H. Clem

George R. Lawson

and development. He will devote his time exclusively to the development of new technical electroplating processes involving gold and silver.

Court Awards Kelite Damages

The United States District Court, Northern District of Illinois, Eastern Division, on September 15, 1959 decreed that *Kelite Corp.* recover from *Klem Chemicals, Inc., Steven Karas, Terell W. Fondren, Harlan S. Walkup, Ralph M. Johnson* and *Lawrence S. Dwyer,* jointly, damages in the amount of $90,000.00. This is the result of legal action brought by Kelite against the defendant for infringement of United States Letters Patent 2,381,124 and wrongful misappropriation of trade secrets.

Pennsalt Names Clem and Lawson

In a move to place more emphasis on its marketing activities, *Pennsalt Chemicals Corp.* has created the new office of vice-president of marketing. *Albert H. Clem,* experienced executive in sales and service, has been named to the post. Replacing Mr. Clem as general manager of the Chemical Specialties Division is *George R. Lawson,* formerly director of marketing for the Industrial Chemicals Division.

A graduate of Pennsylvania State University with a degree in Chemical Engineering, Mr. Clem joined the firm in 1938 as a chemist. He became a sales service representative the following year in what was then known as the Pennsalt Cleaners Dept., with headquarters in Detroit. Following five years' service with this department and two years in the Navy, he returned to Philadelphia as product supervisor in the Special Chemicals Dept. in 1946.

Mr. Lawson, a graduate of Yale University, where he received his B.A. in Chemistry in 1927, joined the company in 1946 as a salesman in the Sharples Chemicals operation. Previously, he had been engaged in research and technical service for the Hood Rubber Co. and the Barrett Division of Allied Chemical Corp.

Conforming Matrix Forms New Division

Gerald D. Minnick has been appointed director of the new Semi-Conductor Equipment Division of *Conforming Matrix Corp.,* Toledo. Mr. Minnick, who has been engaged in machine design and development for 22

Gerald D. Minnick

Leo McHue

years, has headed the product development department of the company for nine years. He is a member of the Society of Plastic Engineers and the American Society of Tool Engineers.

The new division will concentrate on the development of machines for coating co-axial lead components.

Also announced was the appointment of *Leo McHue,* general manager, to the post of vice-president. McHue has served in production and sales capacities with the firm for eight years.

Promotions Announced by Kaykor Industries

Kaykor Industries, Inc. announces the following promotions in the sales and technical service departments: Western sales manager, *G. G. Schmuck,* 46 Skipper Rd., Pittsburg, Calif.; Southeastern sales manager, *H. E. Rubin,* 627 Roberts Ct., Aberdeen Md.; Manager of technical service, *C. Conkling,* located at the plant at 4391 S. Broad St., Yardville, N. J.

Product: 99.75+% Pure
Service: 100% Sure

Every batch checked. Every can filled with a full weight of extra high quality 99.75+% Chromic Acid. Prompt delivery from ample factory and nearby distributor stocks. Why not order BFC Chromic Acid next time?

BETTER FINISHES & COATINGS, INC.
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Sales Appointments Announced by Carborundum

Three appointments in the sales branch of *Carborundum Co.'s* Bonded Abrasives Division have been announced recently.

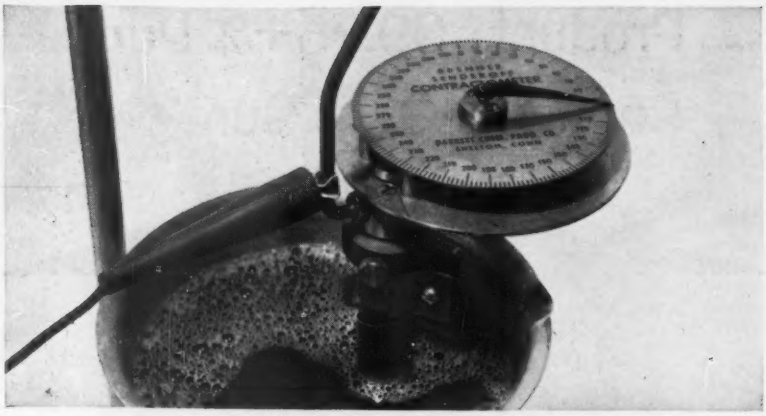
D. H. Currie, product manager for vitrified products — metallic applications, is appointed field sales engineer for the Buffalo sales district. *P. R. Thomas,* field sales engineer for the Detroit sales district, is appointed product manager for vitrified products—metallic applications. *A. E. Bennett,* assistant product manager of resinoid products for metallic applications, is appointed field sales engineer for the Detroit sales district.

Nu-Lite at New Location

Nu-Lite Plating Equipment Co., Inc., manufacturers of plating equipment, have moved to 777 Meeker Ave., Brooklyn 22, N. Y. They carry all types of gears and cylinders in stock and do their own coating on special equipment.

Finish Engineering Co. in New Plant

Finish Engineering Co., Erie, Penna., makers of decorating equipment, has just moved into their new plant, with more than 26,000 square feet of floor space and 4½ acres of ground for further expansion. All on one floor



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. . . when you use the BARRETT SULFAMATE NICKEL PLATING PROCESS, the only nickel plating process which is essentially stress free as measured by the contractometer. Only BARRETT SULFAMATE NICKEL eliminates peeling, cracking, warping, blistering, distortion, shrinkage and premature fatigue failure of the base metal when due to high tensile stress. Complementing this major advantage, the BARRETT SULFAMATE NICKEL PLATING PROCESS also has superior throwing power and ductility, in a plating solution that arrives at your plant "ready-to-operate." Further technical data available upon request for bulletin SN-1. Stress measuring contractometer also available.

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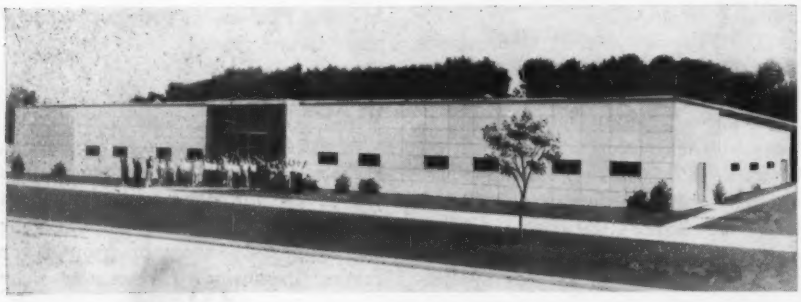
chemical products company, inc.
Shelton • Connecticut

level for efficient operation, there's ample headroom for building the largest decorating machines; plenty of space for demonstration runs of equipment before shipping. New enlarged facilities include the most up-to-date equipment for nickel and copper plating.

The new location, 921 Greengarden Road, is less than a block from Route 5 and only five minutes from the airport served by 4 airlines with 64 flights daily.

Founded only eight years ago by *Robert B. Way* and *Carl Hersey*, the company has had a phenomenal growth in the design and production of spray masks, vacuum plating racks, mask washers, spray machines and fixtures, paint wiping machines, decorating screens and fixtures, and roller coaters.



Cluff Honored by Stevens

Joe Cluff (left) being presented with the Metal Finishing Old Timer's Key by Augie Hoefer, vice president.

Joe Cluff, who retired recently from *Frederic B. Stevens, Inc.*, was given a dinner in his honor at the Detroit Athletic Club. Congratulatory speeches were tendered him, and he was lauded for his many years of outstanding leadership.

At the request of *Joan Wiarda* of METAL FINISHING, Mr. Cluff was presented with the Metal Finishing Old Timer's Key. He also received a travel gift certificate.

Ransohoff Adds to Staff

Ransohoff Co., Hamilton, Ohio has announced the appointment of *Milton R. Watko* as chief engineer.

Watko obtained his engineering training at both Lawrence Institute of Technology, and Butler University before going to work as a consulting engineer on industrial finishing systems. He brings 15 years of experience in industrial finishing to his new position.

Before the new appointment, Watko was chief engineer of the Machine Division, International Conveyor & Washer Co. He is a member of the Engineering Society of Detroit and the American Society for Metals.

Harry L. Burnham has joined the staff as sales engineer. For the past eleven years he has been associated with Phillips Mfg. Co., Chicago, manufacturers of degreasing equipment where he served as service engineer, New England sales representative, and sales manager.

Burnham was graduated from Hillyer College, Hartford University, Hartford, Conn. He will act as sales

engineer in northern Missouri, central Illinois, and northern Indiana.

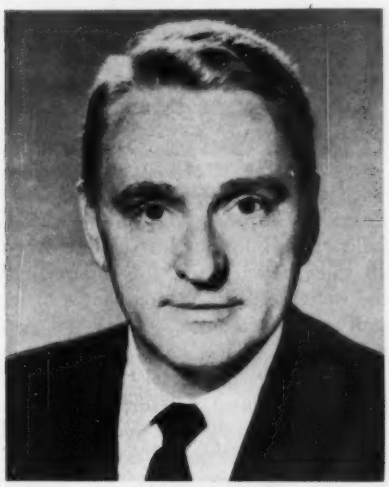
Worklon Opens Western Branch Office

Worklon, Inc., pioneer manufacturers of special purpose industrial uniforms, have announced the opening of a western branch office at 1007 Madison Ave., Los Angeles, Calif. According to *Marvin Maltz*, western sales representative and manager of the new office, the new branch makes it possible to offer quicker, more personalized service to its west coast customers.

The Los Angeles office will carry complete stocks of the entire line of lint-free, acid-resistant garments.

Venghaus Joins Narda Ultrasonics

Walter H. Venghaus, specialist in manufacturing and fiscal control, has joined *Narda Ultrasonics Corp.*, Westbury, N. Y., as vice president and manager of manufacturing.



Walter H. Venghaus

Mr. Venghaus, a resident of Oyster Bay Cove, L. I., was formerly associated with National Research Associates, Inc. of College Park, Md., and has held executive positions with Flight Refueling, Inc., Baltimore; Reaction Motors, Inc., Denville, N. J.; and Industrial Acoustics Co., Inc. He also was previously associated with the consulting firm of Frederick E. Anderson, Inc., New York.

Mr. Venghaus, who studied at Brooklyn Polytechnic Institute and Purdue University, has held memberships and various offices in such organizations as The Aircraft Industries Association, National Society of Cost Accountants, the National Society for Business Budgeting and the American Management Association.

GRIND
POLISH
BUFF
DEBURR

with a Hammond ROTARY AUTOMATIC

SEND SAMPLES and we'll show you how much you can speed production and cut costs.

Model "K" Hammond Automatic Finishing Machines are made in 34", 46" and 62" table sizes. These models are either continuous or for indexing at 150 to 1700 indexes per hour. Head styles include floating, non-floating with 3 H.P. to 20 H.P. range. Also available are attachments for converting heads from buffing to abrasive belt polishing. The Hammond Model "K" will speed up your grinding, polishing, buffing, brushing and de-burring operations. Send us samples and learn how much you can speed them up.

Hammond Machinery Builders INC

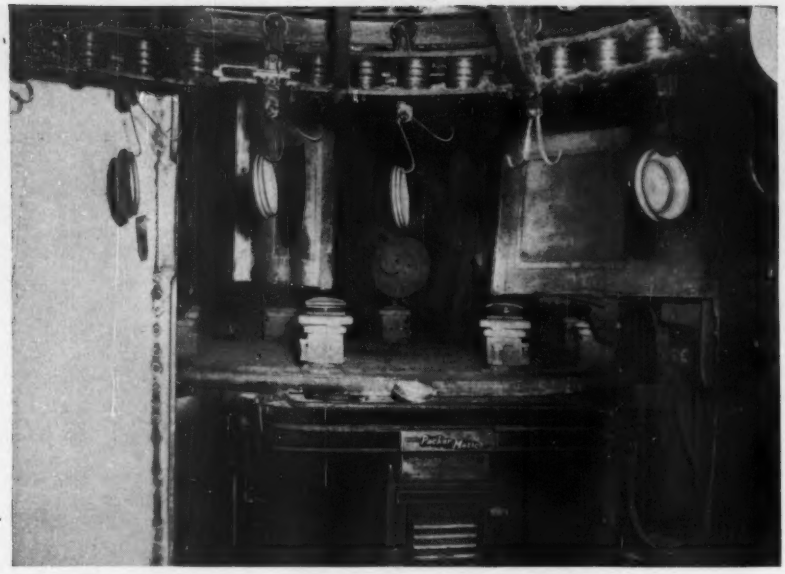
1601 DOUGLAS AVENUE KALAMAZOO, MICHIGAN

Geyer Promoted at Amchem Products

John Geyer, manager of the Product Development Department, Metalworking Chemical Division, *Amchem Products, Inc.*, Ambler, Pa., has been promoted to technical assistant to President *Gerald Romig*. He will be succeeded in the department by *Hugh Gehman*, who has been his assistant since January, 1955.

Geyer, a native of Philadelphia and a graduate metallurgical engineer of the 1949 Class of Lehigh University, joined the firm in December, 1950, as a metalworking chemical technician,

J. H. Geyer



24 million pot lids can't be wrong!

Ask your wife. She will tell you about famous Revere Ware. Probably best known by their copper bottoms, the durable luster of pots and pans by Revere is taken for granted.

"Taken for granted" is exactly the phrase applied to the 3 Packer-Matic polishing and buffing units in Revere's Rome, N. Y. plant by Mr. F. W. Merry, Assistant Works Manager. "We feed them and our Packer-Matics do the rest," says Mr. Merry. "They haven't failed us in 23 years of high production rate operation." "They get a good clean up twice a year and that's about the extent of our maintenance."

Achieving highly reflective finishes on pot lids is only one of hundreds of polishing, deburring, buffing and cleaning applications Packer-Matics have handled since Mr. Clifford I. Packer turned out his first unit in 1927. Chances are we can help you in your finishing operations, too. Send us samples with your specifications or blueprints and see.

Production reliability makes Packer-Matic the choice of companies like Revere Copper and Brass Inc.

PACKER-MATIC

THE PACKER MACHINE COMPANY • MERIDEN, CONN.

Pioneer Manufacturers of Automatic Polishing & Buffing Machines

becoming manager of the Metalworking Chemicals Development Department in 1953. Prior to this he was a plant metallurgist with the Aluminum Co. of America, Massena, N. Y.

Perham Named by Metals & Controls

J. Newton Perham, formerly plant manager of Hero Mfg. Co., Middleboro, Mass., has been appointed to the sales and engineering staff of the Precious Metals Department, General Plate Products Group, *Texas Instruments, Inc.* He will work in both headquarters and field sales, serving the rhodium plating solutions market exclusively.

Perham received a Bachelor of Science degree in Industrial Engineering from Northeastern University in 1938. A navy officer during World War II, he was associated with Norton Chem. Co. from 1946 to 1948, and with Hero Mfg. from 1948 until joining Texas Instruments.

J. Newton Perham

Binkerd Named by NRC

R. H. Binkerd has been appointed general sales manager of *NRC Equip. Corp.*, Newton, Mass., one of the leading producers of high vacuum equipment and accessories, and a manufacturing subsidiary of National Research Corp. Mr. Binkerd will have full responsibility for formulating overall sales policies and for supervising the activities of the company's field staff and distributors.

R. H. Binkerd

Mr. Binkerd has been with Alco, a manufacturer of diesel locomotives, nuclear equipment, pressure vessels and other lines of industrial products since 1942. During his tenure there, he held various positions, from purchasing agent to manager of sales and marketing of the Spring and Forge Division in Latrobe, Pa. Prior to these assignments, Binkerd was associated for three years with a large New York advertising agency. He is a graduate of Phillips Exeter Academy and of Harvard University, class of 1939.

Expansion for Atwood Plating

Atwood Plating Div. of *Atwood Machinery Co.* has moved to a larger plant where new specialized plating equipment is in operation as part of a major expansion program. The division was formerly located at 2047 E. 7th St., Los Angeles, Calif., and is now at 2124 E. 51st St.

Manufacturers' Literature

Electroplating Equipment

Frederick Gumm Chem. Co., Inc., Dept. MF, 538 Forest St., Kearny, N. J.

An 8-page bulletin describes the line of plating equipment and supplies being distributed by the firm for leading manufacturers.

Included are immersion heaters, steam generators, vapor degreasers, spray washing machines, temperature controllers, rectifiers, filters, tanks, racks, baskets and plating barrels.

Also described is equipment for testing current density, rack current, plating thickness, pH and corrosion resistance.

Special equipment includes custom-designed automated plating equipment and a patented double oscillating plating cylinder designed to provide improved mixing action combined with movement of the work across the cylinder to insure uniform plating deposit.

Abrasive Finishing of Solid Copper

Lea Mfg. Co., Dept. MF, 16 Cherry Ave., Waterbury 20, Conn.

A new data sheet gives step by step procedures for the abrasive finishing of solid copper stampings, castings, extrusions and spinnings. Data cover satin finishing and bright or high color finishing including recommendations on wheel heading, lubrication, surface speed and type of buff.

Organic Finishes

Mearl Corp., Dept. MF, 41 E. 42nd St., New York 17, N. Y.

A new 4-page brochure entitled "Coating with Nacreous Pigments" has just been issued by the above firm. Sections covering the choice of coating vehicles, coating techniques, undercoats and colors, spray coating techniques, and special color effects, provide completely detailed data for using both natural and synthetic pearl pigments as coating materials.

Vibratory Finishing

Conveyor Corp., Finishing Div., Dept. MF, 30121 Groesbeck Hwy., Roseville (Detroit), Mich.

A four page, illustrated brochure is available describing vibratory-finishing by means of Vibro-mation, a new automatic method of material finishing. Its features are given, as well as twenty-one advantages in using the equipment.

World's Handiest Small Lot Plater

Just load and hang on cathode rod of still plating tank. To unload just pour the work out. Plates any quantity from a spoonful to a pint in practically any solution. Adjustable tilt is held rigidly by two hooks. Send for literature.

Permanent Tank Magnets

Have amazing pick-up strength. Recover parts from tank without stirring up sediment. Sort iron and steel chips and parts from brass, copper, zinc, sawdust, etc., like magic.

Furnished with or without wheels. Single, 3" wide Double, 8¼" wide Triple, 13½" wide Send for bulletin.

Improves plating – Saves money

Portoplater with Double Oscillating Cylinder that ROCKS as it ROLLS. Improved mixing action gives uniformity of metal deposit not even approached by ordinary cylinders. Plates specified thickness in less time, with less metal and less current. All sizes from 6x12 portables to 14x30 regulars. Send for bulletin.

Rod Agitator for Small Tank!

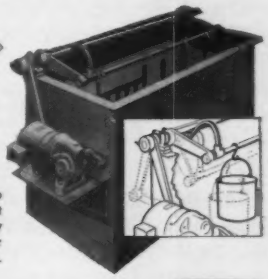
The perfect answer to improved plating of printed circuits, precious metals, costume jewelry. For rods to ¾" diameter. Bolts to tank flanges. Furnished with or without tank. *BELKE makes rod agitators for tanks of all sizes. Send for bulletin.*

Motorized Slusher ⇨

Positive, churning action slushes work up and down. Solution flows in and out of intricate openings. Saves 90% of time required in cleaner bath.

⇦ **Positive Contact**

Cathode hook with powerful spring clamp assures positive contact and full current conductance. Holds the rack exactly where put on the cathode rod. Made for rack stems and cathode rods of all sizes.



Belke MANUFACTURING COMPANY 947 N. Cicero, Chicago 51

EVERYTHING FOR PLATING PLANTS

Government Coating Specifications

Magic Chemical Co., Dept. MF, 121 Crescent St., Brockton, Mass.

This catalog lists one thousand official United States Government specifications covering adhesives, sealants, paints, cleaning compounds, and chemical compounds.

The new edition is divided into eight sections according to Federal Class Numbers and has a complete Numerical Index. The specifications are listed by Government number, title and corresponding proprietary product number.

Spray Booth Coating

Spraylat Corp., Dept. MF, One Park Ave., New York 16, N. Y.

A technical brochure is now available on "Booth Strip," a new water-based non-inflammable, non-toxic booth coating which is applied by any standard spray gun.

Automatic Spraying

Conforming Matrix Corp., Dept. MF, 349 Toledo Factories Bldg., Toledo 2, Ohio.

A brochure describes a method of automatically spraying one, two, or

three surfaces of generally oval or rectangular-shaped pieces of varying length, where fine definition and paint demarcation are imperative.

Electrostatic Coating

Ransburg Electro-Coating Corp., Dept. MF, P. O. Box 23122, Indianapolis 23, Ind.

In this brochure are data on the principles and uses of the No. 2 Process electrostatic hand gun, recently introduced to industry.

Six pages of pictures of actual production applications taken in plants as far away as Australia and showing the regular operators at work, give the reader an idea of the versatility of the electrostatic hand gun.

Chemical Cleaning

Chas. Pfizer & Co., Inc., Dept. MF, 530 Flushing Ave., Brooklyn 6, N. Y.

Technical Bulletin No. 102 contains information on the above firm's products for chemical cleaning. Among the topics covered are stainless steel cleaning, aluminum metal and aluminum alloys, aluminum etching, general chemical cleaning, alkaline derusting and paint stripping.

Cleaning - Phosphating

Frederick Gumm Chem. Co., Dept. MF, 538 Forest St., Kearny, N. J.

An 8-page pamphlet describes Clepo-Phos 196 and 196-F powdered compounds designed to remove light oil and phosphate steel surfaces rapidly in one operation prior to painting.

Hot-Dip Aluminum Coating

Arthur Tickle Engineering Works, Dept. MF, 21 Delevan St., Brooklyn 31, N. Y.

A new brochure is available on hot-dip aluminum coating to prevent atmospheric corrosion and high temperature oxidation and scaling of ferrous parts. Also described is another anti-corrosion method: metal spray coating for parts too large to hot-dip.

Electronic Solution Controller

Electro Mechanisms Corp., Dept. MF, 7301 Ridgeway Ave., Skokie, Ill.

A 4-page bulletin describes a new electronic solution controller, for automatic control of concentration of caustic, acidic or aqueous solutions in either continuous or batch-type metal washing equipment, plating processes, chemical process systems, and other applications where precise concentrate levels must be maintained. Also described are system components: sensing electrode, magnetic amplifier, pump assembly, wash tank and holding tank.

Spray Paint System

Nordson Corporation, Dept. MF, Amherst, Ohio.

The above firm announces the availability of an eight page, illustrated brochure on its hot airless spray paint system. Information is given on the theory and practice of the airless process—the idea behind the system, how its works, the equipment, and the advantages.

DEPENDABLE PPI PRODUCTS

RUBBER AND PLASTIC DRUM LINERS
MONEL, STEEL, COPPER AND TITANIUM ANODE HOOKS
PLASTIC COATED PAILS AND DIPPERS
POLYETHYLENE TANKS AND PAILS
TITANIUM ANODE SCRAP SAVER BASKETS
TITANIUM HEATING COILS
TRICHLORETHYLENE
PERCHLORETHYLENE
SILVER BRIGHTNER
SWIMMING POOL CHEMICALS
OIL ABSORBENT
ACID TANKS AND CONTAINERS
HAND CHEMICAL PUMPS

NEW • DURABLE • LIFETIME

PPI TITANIUM ANODE HOOKS

This New Titanium Anode Hook Is Almost Indestructible When Used With — Nickel, Chrome, or Acid Copper Plating Solutions

Advantages that will save you money . . .

- No chemical or electrochemical attack on titanium hooks by plating solution
- No foreign metal to contaminate solution from the titanium hooks
- Titanium hooks can be placed completely under plating solution level . . . thus, minimizing scrap loss
- Hook threads will not decompose in plating solution
- No electrolysis on the surface of titanium that is exposed to the solution; therefore, hooks will not generate gas or decompose brighteners

NOTE: Titanium metal can't be used in cyanide or fluoborate solutions

PATENT PENDING

Titanium Anode Hooks are made of ⅜" square stock in 3½" thru 8" graduated lengths to fit 1½" dia. anode rod size or less. Special size hooks quoted upon request. PPI makes a complete line of anode hooks . . . Write today for prices and complete details.

A Few PPI Territories Open For Distributors . . . write for details

PLATING PRODUCTS, Inc.

1509 N. WASHINGTON
KOKOMO, INDIANA

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Columbus Branch

The monthly meeting was held at Battelle Memorial Institute with 20 present. The meeting was called to order by president *Marvin Pingel.* The secretary's and treasurer's reports were read and approved. The Cincinnati report on the Tri-State Meeting was discussed. *Lloyd M. Welker* was elected to membership.

Librarian *Hugh Miller* introduced the guest speaker of the evening, *Edward B. Washburn* of Enthone, Inc., New Haven, Conn. His subject was "The Stripping of Electrodeposits." He gave a detailed account of the chemical compositions and operating conditions of strippers for the entire gamut of electroplated coatings. During the subsequent question period he offered solutions to several specific problems posed from the audience. The meeting was adjourned, and refreshments were served through the courtesy of the Diamond Alkali Co.

Leslie D. McGraw

Buffalo Branch

The branch held its meeting Friday, Nov. 6, at the Niagara Manor in Buffalo, N. Y. with 24 members and 3 guests in attendance. *Harold Shapiro,* 1st vice president, introduced the guests and gave a report on the status of branch membership.

After the business session, Librarian *Dick Davis* introduced the speaker of the evening, *James H. Peacock* of the Duriron Co., Inc., who spoke on "Metals and Plastics for Handling Plating Solutions." *Robert Fooksman,* local representative of the company, assisted the speaker.

The February meeting will be held on the 8th, at the regular meeting place. *Christopher Marzano,* chief chemist of Amphenol-Borg Electronics Corp., will speak on "How to Plate Difficult Metals."

Robert E. Lienert,
Secretary

Phoenix Branch

Twenty-six members and guests en-

joyed the excellent dinner at the Faculty Dining Room of Arizona State University, Tuesday, Nov. 10. President *William Griff* opened the business meeting at 8:00 p.m. Application for membership was received from *Ronald Dezember,* Braun Chem. Co.

Delegates and Alternates for 1960 were appointed, as follows: Delegates —*James Weaver, William Griff* and *John Mullarkey;* Alternates—*Sam Lewin, Dean Hill* and *Paul Wible.*

The Ft. Worth-Dallas Air Space Symposium was mentioned. Mr. Weaver acted as delegate to attend this meeting in December. Pros and cons of having a Christmas Party were discussed by *Bob Axsom.* Members voted to have a party but not to include a dinner.

After the business meeting, *Dr. Clyde Crowley* introduced *Dr. Merle C. Nutt,* Dean of Metallurgy A.S.U. Dr. Nutt conducted the group on a tour of the Engineering Laboratories of A.S.U. After the tour, a regrettably brief talk was given on metallurgy by Dr. Nutt. We hope we can again have Dr. Nutt so we can devote more time to such an excellent speaker.

St. Louis Branch

The second fall meeting was held at the York Hotel Wednesday night Nov. 11, with 14 members and guests arriving in time for dinner, but there were 29 members and guests present when the business meeting was called to order by President *William Piel.*

One new member was elected. The minutes of the previous meeting were read and approved. The treasurer gave his report and added that the per capita tax had not been paid. Correspondence consisted of the letter from headquarters squelching the rumor that the 47th Annual Convention might be transferred. The secretary was instructed to report to headquarters that there probably would be 25 men, 6 women, and 10 children attending the Los Angeles convention from St. Louis.

Louis Berra reported the school was being attended by 28 students and progressing very nicely. *Andy Julius* reported there were 255 registered at the Mid-West Regional meeting. The organic educational sessions were attended by about 80, with the others attending the inorganic sessions. Besides Andy Julius and *Craig McAlister,* who served on committees, St. Louis was represented by *Robert Coulson, William Piel, Joe Stevens,* and *Edward Sertl.*

Gerry Clooney suggested that we reactivate the question box and use a telephone committee to call the members to get them out to the monthly meetings. Mr. McAlister was appointed to take charge of the question box and Mr. Clooney accepted the position of chairman of the telephone committee.

At this point, the meeting was turned over to *Richard Gotsch* who introduced *Arnold E. Pavlish* of Cleveland Supply Co. who talked on Problems In Plating. Mr. Pavlish was given a rising vote of thanks for his talk, which promoted a very active question and answer session, and was considered by many the most informative talk heard in a long time.

Ward Kelly,
Secretary

British Columbia Branch

A general meeting was held on Monday Nov. 23 at the Lougheed Hotel, Highway, Burnaby, B. C. There were 29 members and guests present, cocktails and dinner preceded business. The meeting opened at 8:30 p.m. with President *N. A. Shepherd* in the chair.

The secretary reported the resignations of Mr. Bain and Mr. Grist. These were received by the meeting, with regret. A copy of a letter written by the secretary to the Upper Midwest Metal Finishing Association, and their reply, was then read to the meeting. This letter followed the recent publication of resignations from the Twin Cities Branch, of the A.E.S., and was written at the request of this executive.

The president advised the meeting that it was hoped to arrange for a Christmas meeting for this branch, at which members could entertain wives and friends. The secretary made a short report on enquiries made in this direction. A show of hands indicated that the majority of the meeting favored such a project being arranged. A motion to leave all arrangements in the hands of the executive did not obtain approval. *J. Lee* moved, with *C. Schlossereck* seconding, that the executive appoint a committee to set up a Christmas Party at a maximum of 2 dollars per person, with no dancing, but music etc. at such a location as this. *W. Cragg* moved an amendment to this by including dancing. *G. Smith* moved a further amendment that the cost be raised to 3 dollars per person, and the motion then was carried.

The president then advised the meeting that, due to the lateness of the hour, *Jim Lee* would not speak on items of interest connected with his visit to plating shops in the Naval Base at Bremerton, Wash., but would like to include this in a future meeting. Following a short recess, *Geno Gamma,* a well known local skin diver, gave an extremely interesting and informative talk on his work. Mr. Gamma displayed skin diving equipment, and spoke of the important role of good electroplating in this field, in the protection of this equipment against corrosion. Following this talk, Mr. Gamma invited questions from the floor. The meeting adjourned at 11 p.m.

D. A. Armstrong,
Secretary

▸NEW CONCEPT ▸NEW DESIGN ▸NEW ECONOMIES

To Remove OILS, GREASE, SLUDGE

• In this newly-designed A-F Job Engineered Wash-Rinse Machine, for a leading manufacturer of automotive assemblies and components, *two* tanks are heated with a *single* gas burner, with a *single* set of controls.

RESULT: Appreciable savings in original cost—and in heating and operating costs.

Savings like these indicate why, because of today's shrinking profits, progressive management is finding this a *good time to invest* in new A-F Cleaning and Finishing Machines.

Whatever *your* problem in this field, A-F can help you solve it.

Why not write us—without obligation—today?

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A-F JOB *ENGINEERED* Cleaning and Finishing Machines
Plant-Wide Conveying Systems
The Alvey-Ferguson Co. • 500 Disney Street • Cincinnati 9, Ohio

Philadelphia Branch

The Seventh Interim Meeting of the American Electroplaters' Society and 50th Anniversary of The Philadelphia Branch will be held February 19-20, 1960 at the Benjamin Franklin Hotel, Chestnut at Ninth Street, Philadelphia.

PROGRAM

Friday, February 19

1:30 P. M.—Register at hotel and receive badge.

2:00 P. M.—Leave by bus from hotel for tour of *American Machine and Metals, Inc.* plant, Sellersville, Pa.

4:45 P. M.—Leave Sellersville by bus and return to hotel.

6:15 P. M.—Dinner at hotel—Dutch treat.

7:30 P. M.—Opening of 50th Anniversary Technical Session.

8:00 P. M.—First Technical Session. Dr. W. Andrew Wesley, First Vice President, American Electroplaters' Society, Manager of Research Laboratory, International Nickel Co., Bayonne, N. J., *The Search for the Causes and Remedies for Corrosion of Nickel-Chromium Coatings.* John B. Winters, Incar, Inc., *Cadmium & Zinc Troubles.*

Saturday, February 20

10::00 A. M. — Interim Meeting, American Electroplaters' Society, morning session.

10:00 A. M.—Second Technical Session—Aluminum Symposium. Dr. Harold J. Wiesner, Research Chemist, Bendix Products Division, Bendix Aviation Corporation, South Bend, Ind., *Hard Anodizing.* Russell V. Vanden Berg, Aluminum Company of America, New Kensington, Pa., *Anodizing & Chemical Finishes of Aluminum.* William K. Murray, Manager of Marketing, Enthone, Inc., New Haven, Conn.,*Plating on Aluminum.*

1:00 P. M.—Informal luncheon.

2:00 P. M.—Interim meeting, afternoon session.

6:00 P. M.—Metal Finishing Suppliers' Association Cocktail Reception. 7:30 P. M.—50th Anniversary program.

8:00 P. M.—Banquet, show and dance.

Philadelphia Branch 50th Anniversary Committee Chairmen: —*General Chairman,* James E. Cogan, Jr.; *Banquet Tickets and Table Reservations,* Donald H. Marsh; *Cocktail Reception,* William H. Brown; *Door Prizes,* David Thomas, Jr.; *Educational Session,* Dr. Samuel Heiman, Joseph W. Berenato, Jr.; *Entertainment,* John R. Ross; *Finance,* Paul Mentzer, Sr.; *Hospitality,* William H. Trusdell; *Hotel,* William H. Moyer; *Ladies Program,* Vincent H. Casswell; *Plant Visitation and Secretary,* I. Wm. Marcovitch; *Program Book,* Kenneth W. Clayton; *Public Relations,* Irvin K. Hauseman; *Registration,* Edward M. Hoffmann, Jr.

Blue Ridge Branch

The branch met Dec. 5 at the Elks Club in Roanoke, Va. Twenty-three people assembled, ladies and gentlement, from Greensboro and Winston-Salem, N. C., and Blacksburg, Roanoke, Bristol, Narrows, and Staunton, Va. *Dr. Nelson F. Murphy* presided. New memberships were announced for: *Milvi Ojakaar,* Polyscientific, Blacksburg; *Robbie H. Glass,* Polyscientific, Blacksburg, and *Alexander E. Groves,* Brame Textile, Greensboro; also announced were intransfers: *George Lefevre,* AMP, Inc., Greensboro, from Lancaster Branch; and *Del Taylor,* General Metals Fin-

FORMAX
ZIPPO
SISAL BUFFS
A Dual-Purpose
Polishing and Buffing Wheel!
Call for Zippo Sisal Buffs when you have need for a fast cutting, heavy duty wheel to remove surface imperfections from ferrous metals. You will find they serve excellently to blend and smooth stretcher strains, orange peel, light die marks and polishing wheel grit lines. And—at the same time leave a bright surface finish.
Write for Descriptive Literature
FORMAX MFG. CORP.
DETROIT 7, MICHIGAN
"THE FOUR McALEERS"

NEW!
defies chemical attack, heat
"in tank" PUMP
and
outside FILTER
with detachable
FILTER CHAMBER
Model UAL-20 200-300 Gals./Hr.
other models from 50-1200 Gals./Hr.
Compact, takes little space in tank
It's corrosion proof . . . handles all acids and alkaline solutions up to 250°. Self-priming, leakproof EPOXY sump pump provides continuous duty performance. Bracketed inside the tank, it requires no floor space. Outside bracket supports High Temp. Lucite or Epoxy filter chamber . . . ½ or ¾ HP motor. Pump and filter chambers are available separately.
For complete details: WRITE for Spec. Sheet No. 751B
Sethco
MANUFACTURING CORP.
NEW Illustrated 8 page Brochure, BULLETIN M-1. Complete catalog of Sethco Filters from 50 to 2700 Gals/Hr.
MAyfair 3-4220 • 2286 Babylon T'p'ke, Merrick, L.I., N.Y.

ishing, Greensboro, from Cincinnati Branch.

Dr. Henry Leidheiser Jr., director of research at the Virginia Institute for Scientific Research spoke on, "Micro-throwing Power — A.E.S. Project 17", illustrated with color slides and blackboard.

Robert H. Probert,
Secretary-Treasurer

Columbus Branch

The monthly meeting was held on Dec. 4 at Ricardo's Restaurant, and was called to order by *Marvin Pingel*, president. The secretary's report was read and approved.

A report on preparations for the Tri-State meeting to be held in Columbus resulted in a motion that the meeting be scheduled for Feb. 4, 1960, with the prior week as an alternate. The motion passed.

Librarian *Hugh Miller* introduced the speaker of the evening, *Bruce Young*, manager of marketing development at Detrex Chemical Industries, Inc., Detroit, Mich. Mr. Young spoke on "Cleaning Metal with Sonic Waves." His description of the use of this cleaning method, coupled with detergents or chlorinated solvents, to remove finely divided residues or smut from metal parts, was well illustrated with slides and an interesting demonstration.

L. D. McGraw,
Secretary

Newark Branch

President Meyer called the meeting to order after the movie ("What's a Silicon") with 56 in attendance.

Six applications were received and *Hal Abrams* of Western Electric, *Charles Barratt* of Electro-Tec, *Stanley Dral* of Remco, *Theodore Ernst* of Rebco, *Robert Harvey* of Branson Ultrasonics, *John Heineman* of Oakite Products, *John Murphy* of Branson Ultrasonics and *Herbert Schiller* of Foremost Mfg. Co., were elected members of the branch.

Dr. D. G. Foulke announced the Products Finishing competition and the Aerospace Finishing Symposium to be held in Fort Worth, Texas. *John Banta* reported on the Christmas Party and *Cy LaManna* on the Electroplating School.

Al Korbelak then introduced *Ray Abazio*, whose Timely Topic was Phosphate Coatings. He listed the types of coatings and pointed out the principal uses for each type. Ray concluded his talk by pointing out applications for phosphoric acid pickling cleaners.

Herb Tilton then discussed in detail the "Engineering and Design of Plating Racks." By means of colored slides the speaker pointed out the methods of fabrication of racks and engineering considerations and concluded by showing a great number of special racks for particular applications.

D. Gardner Foulke,
Secretary

Waterbury Branch

The branch held its regular meeting at the Hotel Elton on Thursday, Nov. 12. A short business meeting was called to order by President *Frank Tirendi*. The entertainment committee reported that plans are progressing for the annual meeting to be held in February. A further report will be presented at the next meeting. *Bill Giesker* reported on the New England Regional Committee Meeting which was held in Hartford. He asked for the sentiments of the Waterbury Branch concerning the

8 FLOORS

120,000 SQUARE FEET

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WITH THE COUNTRY'S GREATEST VALUES IN PLATING, POLISHING and SPRAY PAINTING EQUIPMENT.

- Agitators
- Air Compressors
- Anodizing Equipment
- Barrel Finishing Equipment
- Belt Polishing Machines
- Blowers
- Centrifugal Dryers
- Circulating Pumps
- Degreasers
- Ducts
- Dust Collecting Systems
- Electropolishing Equipment
- Filters
- Furnaces and Ovens
- Generators
- Heaters
- Paint Spray Equipment and Accessories
- Plating Units, Semi and Full Automatics
- Rheostats and Controls
- Rectifiers: Selenium, Germanium, Silicon-Type
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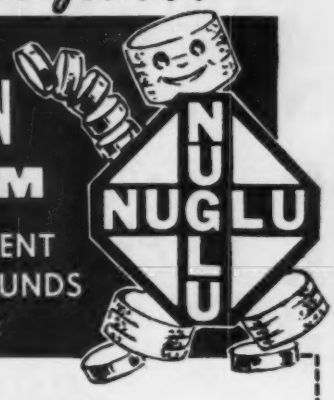

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Regional Committee's plans to do preliminary work for the 1961 Interim Meeting. The Interim Meeting does not fall into the province of the Regional Committee under the present by-laws.

Perry Sloane introduced the speaker, *I. Laird Newell*, president of Henry Souther Engineering Co. who gave an excellent paper on the important subject "Waste Disposal." He discussed the state's attitude, requirements and method of operation, and showed slides depicting some systems that his firm was instrumental in designing. The paper was followed by a lively question and answer period.

F. A. Schneiders
Publicity

New York Branch

President *Joseph Rembecki* called the Nov. 13 meeting to order at 8:30 P.M. at the Statler Hotel. A motion made and carried that applications for membership from *James C. Weekes* of Anton Electronic Laboratory, *George L. Jacobs* and *Louis D. Trupia* of Sperry Gyroscope follow regular course. A motion was also made and carried by an unanimous vote to raise the branch dues to $15.00 a year to cover increase in per capita by the national society.

There will be only one meeting in December, to be held the second week on Friday the 18th. It will be our Christmas Party and there will be refreshments served.

All further business was dispensed with and Librarian *Martin Pollack* took over for "Good and Welfare." Martin introduced *Lionel De Waltoff*, technical director of Octagon Process Inc. whose paper on "Coordination Compounds and Chelates" was very well presented. The membership gave Lionel a rising vote of thanks for a job well done, after which the meeting was adjourned.

Empire State Regional

The 1960 regional meeting will be held April 29-30, 1960 at the Mark Twain Hotel, Elmira, N. Y. The Southern Tier Branch will be the host branch at this meeting.

Los Angeles Branch

A panel discussion on "Customer-Processor Understanding" was presented as the educational feature of the November 11 meeting. Purpose of the discussion, as explained by Librarian *Miss Marjorie Farmer*, was to have the problems, requirements and interrelated functions of the supplier, buyer and plater-user of the plating products and chemicals explained by practical representatives of the various phases of the industry.

The panelists were *Whitey Lund*, plant manager, Atlas Plating Co., who represented the job plater; *Earl Arnold*, L. H. Butcher Co., representing the supply house; and *Robert Martin*, purchasing manager, Norair, Inc., *Irving Greenwald*, North American Aviation, Inc., and *R. J. Singren*, of Calmec Mfg. Co., representing the producers of parts who sublet plating contracts to outside shops.

Each panelist was allowed 12 minutes in which to set forth the functions of his job, and what was demanded of job platers in bidding for work from large manufacturers. After the five panelists had addressed the 85 members and guests, the audience was invited to ask questions.

Mr. Martin explained what his firm

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demands in the way of "ability to process to specifications" from job shop owners seeking work from his firm. Mr. Arnold discussed the relationship of the supplier of equipment and chemicals to the job shop plater and how this relationship also encompasses the manufacturer.

Mr. Greenwald discussed quality control and the safeguards major air craft and parts companies have set up to assume that sub-contracting plating shops are qualified to process according to specifications. Mr. Lund discussed the practical job plater's approach to the problem of acquiring and doing contract work for large parts producers. Mr. Singlin discussed heat-treating, how it affects and applies to plating, and how the shop operators must proceed to obtain contracts for that type of work. In conclusion, Miss Farmer tied the five short speeches and the gist of the queston-and-answer period into a concise summary.

President *George Hetz* initiated seven new members. These were *Ed. J. Johnson, John Molina, Robert Jones, J. M. Wall, Wayne Gaunt, H. R. Morrison* and *Charles Humbert.*

Hetz, as co-chairman of the 1960 AES convention, announced that the program is shy three talks on organic finishing subjects. He requested members who have ideas for suitable talks to contact the convention committee.

Oscar Grisat, chairman, Research Committee, reported addition of two new sustaining members — Peterson Plating Co. and Burton Silver Plating Co.

Guests in attendance at the November 11 meeting included *R. J. Singren,* Calmec Mfg. Co., and *Mrs. Singren; G. H. Weiner,* Shipley Co., Inc.; *Stanley S. Krentel,* executive vice-president, MacDermid Inc., Ferndale, Mich.; *R. R. Brookside,* Products Exchange Co.; and *Frank Guzman,* member of Louisville, Ky., A.E.S. branch, a transferee to Los Angeles Branch.

Chicago Branch

The regular monthly meeting was held Friday, Nov. 13, at Stella's Restaurant, 3206 N. Kostner Ave. In spite of the inclement weather, a good turnout of members were present at the meeting. Five applications for membership were turned over to the board of managers for approval. *Simon Gary* suggested that a housing committee be appointed for the purpose of selecting another site for future meetings of the Branch.

The 48th Annual Education Session and Banquet will be held on Saturday, January 30, 1960, at the Conrad Hilton Hotel. The educational session will begin at 2:00 p.m. and the panel will be *Cleve Nixon,* General Motors; *Joseph Gurski,* Ford Motor Co. and a representative from the Chrysler Corp. Cocktails will be served from 6:15 to 7:15 p.m. and the banquet will start at 7:30 p.m. in the Grand Ballroom. *Frankie Masters* and his orchestra will furnish the music for the floor show and dancing till 1:00 a.m.

The First Annual Conference of the Midwest Regional Council which was held on Saturday, Nov. 7, at Rockford College in Rockford, Ill., was indeed a success! *Dr. William Blum* of Washington D. C., was guest speaker at the luncheon and his subject was "Education and Electroplating Industry." *Simon P. Gary,* librarian, introduced the speakers of the evening, *Al Weisberg* of Technic, Inc., and *Eric Jacob-*

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sen of James Plating Works. Their subject was "Precious Metal Plating Today." Mr. Weisberg spoke on the applications of gold for (1) missiles (2) printed circuitry (3) electrical contacts and (4) decorative plating. Mr. Jacobsen discussed decorative and industrial (specification) gold plating.

Christopher Marzano,
Publicity Chairman

Indianapolis Branch

The second branch meeting at the new meeting place, The Construction League, of 1456 N. Delaware, was very much enjoyed by thirty-five members and guests on Dec. 1.

The following new members were voted into the society: *Robert B. Adams, Dan J. Branch, Dean W. Royalty, Walter W. O'Brien* and *Cecil Overholt*. One transfer member was introduced from the Hartford Branch, he was *Earl F. Taylor*.

Lapel pins will be ordered by the treasurer for any member who desires one and a reminder will be sent with the statements. *Quentin Shockley* reported on the Tri-State past and future plans. As the general fund of the Tri-State is slowly decreasing, the by-laws are to be revised to remedy this condition. The next meeting is in Cincinnati, and tentative plans are to have an educational session in the morning with two papers given and three papers to be given later in the afternoon. A $3.00 registration fee will be charged for those who wish to attend the educational sessions only. A full report on the Louisville meeting will come out soon.

Beyond any doubt the program for this meeting proved to be about the best in many a year. *Mark Trock*, librarian, introduced *Jack Kerr* of Reynolds Metals Company, who talked on "Finishing of Aluminum." Mr. Kerr was a very humorous and clever speaker but never failed to bring one back to the subject before ending each sentence. Mr. Kerr had a complete miniature set-up present and proceeded to show how to anodize. He displayed many samples of the finish and, following the demonstration, a question and answer period took place. After many good laughs and much good information about anodizing, it was agreed upon by all that this was truly a good meeting. The meeting adjourned at 9:40 p.m.

Edna Rohrabaugh

Blue Ridge Branch

The branch met Nov. 6 at the Charcoal Steak House in Greensboro, N. C. *Bruce Wallace* presided. The membership of *J. Aubrey Harless*, Polyscientific, Inc., in Blacksburg, was announced.

Theodore Voyda, technical director, Apothecaries Hall Co., a division of Hubbard Hall Chem. Co. of Waterbury, Conn., was the speaker. The subject was "Anodes and Their Corrosion," covering discussion on nickel, zinc, copper, and chromium plating anodes, types, and effects on anode corrosion by chemical additions, impurities, and other physical considerations.

Robert H. Probert,
Secretary

American Society for Metals

The second Southwestern Metal Exposition and Congress will be held at the State Fair Park and Sheraton, Dallas, Texas, May 9-13, 1960. For details contact *Allan Ray Putnam*, managing director of the ASM, Metals Park, Novelty, Ohio.

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ANNUAL EDUCATIONAL SESSION
February 6, 1960
STATLER HILTON HOTEL — NEW YORK CITY
Technical Session — 2:00 p.m.
Dinner-Dance - 7:00 p.m.

Vacuum Coaters to Meet in New York

The Society of Vacuum Coaters will hold a winter meeting and technical conference at the Hotel Biltmore in New York on January 26th and 27th.

PROGRAM

Tuesday, January 26, 1960

10:00 A.M.-12:00 Noon—Committee Meetings.

1:00 P.M.-5:00 P.M.—Registration.

2:00 P.M.-5:00 P.M.—Business Meeting.

5:00 P.M.-12:00 P.M.—Social Period, Biltmore Room.

Wednesday, January 27, 1960

Moderator—*B. H. Hineline,* Haloid Xerox, Inc.

9:00 A.M. — Opening Address.

9:30 A.M. — *Automation in Lens Coating* — William Kennan, Eastman Kodak Co., Hawk Eye Works.

10:00 A.M. — *Thick Film Functional and Decorative Coatings* — P. J. Clough, National Research Corp.

10:35 A.M. — *Equipment Design for Maintaining Dust Free Conditions* — J. G. Liskow, American Air Filter Co., Inc.

11:15 A.M. — *Lacquer Automation and Vacuum Metalizing* — R. J. Perkel, Jema-American, Inc.

11:40 A.M. — *Vacuum Chamber Problems in Decorative Metalizing: Discoloration, Filaments and Techniques* — Leslie Winters.

12:15 P.M. — *A Commercial Cold Mirror* — James Law, Bausch & Lomb Optical Co., prepared by H. H. Schroeder and A. F. Turner.

1:00 P.M. — Luncheon.

2:00 P.M. — Reconvene.

Moderator — *M. A. Self,* Bee Chemical Co.

2:15 P.M. — *Safety Factors for Handling Flammable Materials* — Morgan Jones, Red Spot Paint and Varnish Co.

2:40 P.M. — *Principles of Electrostatic Spraying of Metalizing Coatings* — T. E. Hayden, Bee Chemical Co. Prepared by John Scharnberg and T. E. Hayden.

3:10 P.M. — *Design and Plan to Metalize* — Fred Borries, G. Felsenthal & Sons, Inc.

3:35 P.M. — *Vacuum Deposited Protective Films* — David H. Baum, Vacuum Equipment Div., The New York Air Brake Co.

Those interested in attending should write to the Hotel Biltmore for reservations as soon as possible.

News from California

By Fred A. Herr

Harry Evans, formerly affiliated with the Atlas Plating Co., Los Angeles, and *Harry Landau,* a metal manufacturer, have established the Sparkle Metal Finishing Co. at 4649 San Fernando Road, Glendale, Calif. The 10,000 square foot plant is equipped with four 1,000 gallon tanks for cadmium, zinc, electroless nickel, and electroless tin plating. Evans reported that the shop is Air Force approved for plating electroless nickel. The partners are set up to do plating of airplane,

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Stanley S. Krentel, Ferndale, Mich., executive vice president of MacDermid, Inc., manufacturers of finishing and cleaning compounds, was a visitor in California in mid-November. Conferences with the firm's west coast technical representative *Claude Weekly,* and visits by Krentel and Weekly to Southern California plating shops were on the visitor's schedule. Weekly, Krentel and the latter's brother, *E. Stuart Krentel* (Kelite, Inc., Los Angeles), a past-president of Los Angeles Branch of the A.E.S., also attended the November 11 meeting of Los Angeles A.E.S. Branch.

The second semester of a television correspondence course for chemical engineers, electrochemists, science teachers, and others interested in the chemical field, will be offered by the Extension Division of the University of California, Berkeley, beginning Feb. 3 and continuing to May 27, 1960.

The first semester was offered from Sept. 28, 1959, to February 2, 1960. The course is coordinated with the NBC-TV Continental Class Room. It combines television instruction over five California TV stations and correspondence instruction. Offered is a survey of the fundamental principles of chemistry and a study of recent developments emphasizing structures of chemical species.

The television instruction is presented by *Dr. John F. Baxter,* professor of chemistry, plus guest lecturers distinguished in various fields of chemistry. The correspondence phase of the course is directed by *Dr. Richard M. Diamond* of the chemistry staff of the University of California's Lawrence Radiation Laboratory.

The first semester course was entitled Modern Chemistry X350, the second semester, Modern Chemistry X355. The television part of the course is broadcast from 6:30 a.m. to 7 a.m. daily, Monday through Friday, over TV Stations KRON San Francisco, KRCA Los Angeles, KCRA Sacramento, KMJ Fresno, and KFSD San Diego.

The sponsors are the American Association of Colleges for Teacher Education, the American Chemical Society and the National Broadcasting Co.

Eighty of the country's leading corrosion engineers, representing manufacturing firms and the military, attended the surface preservation conference of the American Ordnance Ass'n's 26th meeting in Santa Monica, Calif., October 19-21.

Discussion centered on solving corrosion problems involved in missiles and rockets. Among the speakers were *F. L. LaQue,* vice-president, International Nickel Co., and *Myron B. Diggin,* vice-president, Hanson-Van Winkle-Munning Co. Plant visitations and seminar discussions at Douglas Aircraft Co., Santa Monica, and Norris-Thermador Co., Vernon, Calif., were included on the program. Douglas, Norris-Thermador and Turco Products, Inc., were conference hosts.

The Golden Gate Metals Conference of the American Society for Metals will be held in the Fairmont Hotel, San Francisco, February 4 to 6. An exhibit of metal products and processes will be held in connection with 4 days of technical conferences. *Dr. Robert Huggins* of the Stanford University faculty, chairman of the technical program, has announced that technical discussion has been designed to conform to the industrial growth of the west which has placed new emphasis on metallurgy.

Kaiser Aluminum & Chem. Corp., has announced plans for constructing a $100,000 addition to its facilities for producing super purity aluminum at its plant in Mead, Wash. Work is reported to be underway on two new refining cells to refine aluminum to a purity of 99.99 plus per cent.

Facilities for buffing, anodizing and heat treating of aluminum are included in northern California's first aluminum extrusion plant which was recently opened up in Watsonville by Pacific Extrusions, Inc., an affiliate of Aluminum Extrusions, Inc., Charlotte, Mich. The new plant is equipped to manufacture and process a wide variety of extruded aluminum shapes for the appliance, building, electrical, electronics, furniture, and transportation industries.

The metal parts problem in missiles is the most important single problem in the missile field, *Lt. Gen. Bernard A. Schriever,* commander, Air Research and Development Command, USAF, declared at the A.S.T.M. third Pacific Area national meeting held recently at the Sheraton-Palace Hotel, San Francisco.

General Schriever addressed a meeting at which the ASTM honored its president, *Frank L. LaQue,* vice-president and manager of the development division, International Nickel Co.

The five-day meeting was attended by 2,000 engineers, scientists and government and industry executives. The program, which included 250 papers presented at 50 technical sessions, was

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devoted chiefly to technical symposia, papers and reports relating to research on engineering materials, and standards for both defense and civilian use.

Dr. Lewis Larmore has been named chief scientist of the Lockheed Aircraft Co.'s California division. In the new post Dr. Larmore heads the company's scientific research activities and also directs plans for a new research center at Saugus, Calif.

The hazard of flash fires from electrostatic sparks in plant areas where coating solvents are used or stored was emphasized in a talk on "Plant Safety" presented by *Gilbert E. Cain*, manager of safety for the Hercules Powder Co., at a recent meeting of Los Angeles Paint & Varnish Production Club. Mr. Cain's talk dealt largely with actual accidents, what happened, how it happened, and how it should be corrected. He stressed electrostatics and the various forms in which this phenomenon builds up to cause solvent ignition.

Oakite Products, Inc., of New York, manufacturers of chemical compounds for industrial and metal cleaning, has named *T. A. Rohlfsen* of Sherman Oaks, Calif., as manager of its Pacific Coast division. Rohlfsen succeeded *J. C. Leonard* who retired recently after a 35 year career with the organization.

Los Angeles Chapter, American Society for Metals, has elected the following new officers: Chairman, *H. A. Curwen*, technical director, Early M. Jorgensen Co., Los Angeles; vice chairman, *William V. Ward*, Lockheed Aircraft Co., Burbank; secretary, *Kenneth L. Clark*, assistant manager, West Coast field section, International Nickel Co.; treasurer, *Edward W. Golda*, technical director, Dodge Copper Products Co., Los Angeles; assistant secretary, *Charles H. Dickson*, chief engineer, Alloy Fabricators, Inc., El Monte.

OBITUARIES

DR. HIRAM S. LUKENS

Dr. Hiram S. Lukens, Professor Emeritus of Chemistry at the University of Pennsylvania, died recently at the age of 74.

He graduated from Penn in 1907 and received his doctorate there in 1913. He joined the faculty at the University of Pennsylvania in 1907, where he taught chemistry for forty-six years, before retiring in 1953.

Dr. Lukens was a past president of The Electrochemical Society. His research and publications were chiefly in the fields of electrochemistry and analytical chemistry, and he held more than a score of American, Canadian, British and German patents.

Surviving are his widow, Marguerite, and a son, William.

JOHN B. TINNON

John B. Tinnon, retired vice president in charge of sales, *Metal & Thermit Corp.*, died Nov. 30 at New

Rochelle Hospital, New Rochelle, N. Y. He was 74.

A native of Fort Worth, Texas, he was graduated from Vanderbilt University in 1908, where he was a member of Phi Delta Theta. From 1912, he was associated with Chicago and Joliet Electric Railway Co., becoming chief engineer. He served with the U. S. Army during World War I.

In 1924 he joined Metal & Thermit and, subsequently, became sales manager. In 1944 he was elected vice president in charge of sales, which position he held until his retirement in 1955.

Mr. Tinnon was active in both church and civic affairs. He is survived by his wife, *Edwine M. Tinnon*, two sisters, and three sons.

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1—Hammond Model 50, 46" Table, 6 spindles, 4—10 HP Heads.
1—Hammond 30" Table, 8 spindles, with 3—5 HP Heads.
20—Murray Way Universal Polishing Heads 5 thru 15 HP with cylinders, Models 51, 52 & 62.
1—Packermatic 60" Table, 12 Spindles, 7 Heads.
1—Udylite 75' Straightline & Return Type Polishing Machine with 10 Polishing Heads; 7—(10 HP) & 3—(5 H.P.)

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1—Production Machine Co. Type A Tube Polisher & Sander (Felt belt).

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2—Divine Double 5 HP Bent-over Model VM-5.
1—Hammond Double 7½ HP Model 7-RROW.
2—Hammond 7½ & 10 HP Model 7-ROW.
1—Hammond Double 5 HP.
2—Hammond 7½ HP Variable Speed Model 7VRO.
1—Hisey Wolf 5 HP Variable Speed.
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8—Henderson barrels 5A tilting type.
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4—#101 Tandum 15 H.P.
2—Production Machine #484-2.
5—Acme A2.
3—Acme B10.
2—Divine Model VM-10 — 10 H.P.
2—L'Hommedieu 5 H.P. variable speed.
15—Holland 5 H.P. — 7½ H.P. — 10 H.P.
1—Acme L-82 — 7½ H.P.
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6—Divine Idlers.

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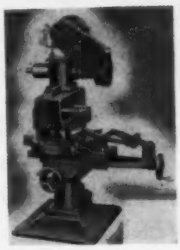

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Infilco, Inc.
P. O. Box 5033, Tucson, Ariz.
Jelco Finishing Equipment Corp.
153 E. 26th St., New York 10, N. Y.
Kelite Corp. 102
81 Industrial Rd., Berkeley Hgts., N. J.
Kocour Company 32
4802 S. St. Louis Ave., Chicago 32, Ill.
Kosmos Electro-Finishing Research, Inc.
140 Liberty St., Hackensack, N. J.
Kushner, Dr. Joseph B. 115
621 S. Norman, Evansville 14, Ind.
Lasalco, Inc. 21
2820-38 Lasalle St., St. Louis 4, Mo.
Lea Mfg. Co. 35
16 Cherry Ave., Waterbury 20, Conn.
Lea Michigan, Inc.
14459 Wildemere, Detroit 38, Mich.
Lea-Ronal, Inc. 36
139-20 109th Ave., Jamaica 35, N. Y.
L'Hommedieu & Sons Co., Chas. F. 5
4521 Ogden Ave., Chicago 23, Ill.
Lindale Equipment & Supply Corp. 116
504 Smith St., Brooklyn 31, N. Y.
Lowe Brothers Co., The
Dayton 2, Ohio
Macarr, Inc. 111
4360 Bullard Ave., Bronx 66, N. Y.
MacDermid, Inc. Back Cover
Waterbury 20, Conn.
Magnus Chemical Co., Inc. 99
11 South Ave., Garwood, N. J.
Mahon Co., The R. C. 20
Detroit 34, Mich.
Manhattan Rubber Div., Raybestos-Manhattan, Inc.
6 Willett St., Passaic, N. J.
Manning, Maxwell & Moore, Inc. Consolidated Ashcroft Hancock Div.
Stratford, Conn.
McGean Chemical Co.
1040 Midland Bldg., Cleveland 15, Ohio
Meaker Company, The
1633 S. 55th Ave., Chicago 50, Ill.
Mearl Corp., The 94
41 E. 42nd St., New York 17, N. Y.
Metal & Thermit Corp. 40
Rahway, N. J.
Michigan Buff Co., Inc. 118
3503 Gaylord Ave., Detroit 12, Mich.
Michigan Chrome and Chemical Co. 10
8615 Grinnell Ave., Detroit 13, Mich.
Motor Repair & Mfg. Co., The 117
1555 Hamilton Ave., Cleveland 14, Ohio
Murray-Way Corp. 14
P. O. Box 180, Maple Rd. E., Birmingham, Mich.
Nankervis Co., Geo. L.
15300 Fullerton Ave. Detroit 27, Mich.
Neilson Chemical Co. 25
2300 Gainsboro, Ferndale 20, Mich.
New Holland Machine Co.
New Holland, Pa.
N. J. Thermex Co., Inc. 100
535 Bergen St., Harrison, N. J.
Northwest Chemical Co.
9310 Roselawn Ave., Detroit 4, Mich.
Norton Co.
1 New Bond St., Worcester 6, Mass.
Nuodex Products Co.
Elizabeth, N. J.
Oakite Products, Inc. 4
18 Rector St., New York 6, N. Y.
Packer Machine Co. 104
456 Center St., Meriden, Conn.
Pesco Plating Equipment Corp. 116
75 Wythe Ave., Brooklyn 11, N. Y.
Pfizer & Co., Inc., Chas.
630 Flushing Ave., Brooklyn 6, N. Y.
Phelps Dodge Refining Corp.
300 Park Ave., New York 22, N. Y.
Plating Products, Inc. 106
1509 N. Washington, Kokomo, Ind.
Plating Service & Equipment Corp. 117
3620 Hart St., Detroit 14, Mich.
Ramco Equipment Corp.
807 Edgewater Rd., New York 59, N. Y.
Randolph Products Co.
92 N. 12th St., Carlstadt, N. J.
Rapid Electric Co. Inside Front Cover
2881 Middletown Rd., Bronx 61, N. Y.
Raybestos-Manhattan, Inc. Manhattan Rubber Div.
Passaic, N. J.
Reliable Industrial Equipment Co. 117
633 Richmond St., Grand Rapids 4, Mich.
Robertshaw Fulton Controls Co., Fulton Sylphon Div.
Knoxville 1, Tenn.
Rona Pearl Corp. Div. of Rona Laboratories, Inc. 112
E. 21st & E. 22nd Sts., Bayonne 3, N. J.
Sandox, Inc. 28
61 Van Dam St., New York 13, N. Y.
Saran Lined Pipe Co. 24
2415 Burdette Ave., Ferndale 20, Mich.
Schaffner Mfg. Co., Inc. 114
22 Herron Ave., Emsworth, Pittsburgh 2, Pa.
Sel-Rex Corp. Inside Back Cover
75 River Rd., Nutley 10, N. J.
Servi-Sure Mfg. Co.
131 N. Green St., Chicago 7, Ill.
Sethco Mfg. Co. 108
2286 Babylon Turnpike, Merrick, L. I., N. Y.
Siefen Co., J. J. 109
5643 Lauderdale, Detroit 9, Mich.
Sommers Bros. Mfg. Co. 115
3439 No. Broadway, St. Louis 7, Mo.
Stevens, Inc., Frederic B. 11
1808 - 18th St., Detroit 16, Mich.
Stokes Corp., F. J. 88
5500 Tabor Rd., Philadelphia 20, Pa.
Stutz Co., The
4430 W. Carroll Ave., Chicago 24, Ill.
Surety Rubber Co.
Carrollton, Ohio
Technic, Inc. 39
88 Spectacle St., Cranston, R. I.
Titanium Products Corp.
9301 French Rd., Detroit 13, Mich.
True Brite Chemical Products Co. 110
P. O. Box 31, Oakville, Conn.
Turco Products, Inc.
24600 S. Main St., Wilmington, Calif.
Udylite Corp., The 17, 38, 93
Detroit 11, Mich.
Unit Process Assemblies, Inc.
61 East 4th St., New York 3, N. Y.
U. S. Stoneware 34
Akron 9, Ohio
Unitron Instrument Div., United Scientific Co. 91
204-206 Milk St., Boston, Mass.
Univertical Corp. 110
14841 Meyers Rd., Detroit 27, Mich.
Virginia-Carolina Chemical Corp.
401 E. Main St., Richmond 8, Va.
Worthy Products Co. 118
Box 123, Temple, Pa.
Wyandotte Chemicals Corp. 33
Wyandotte, Mich.
Zialite Corp. 112
92 Grove St., Worcester 5, Mass.

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Remington Rand, Division of Sperry Rand Corporation, Utica, New York, uses the AUTRONEX ACID GOLD PROCESS to plate printed circuit boards for their world-famous UNIVAC Solid-State Computer Systems and Equipment. Installation of the patented AUTRONEX ACID GOLD PLATING PROCESS for this work, "... totally eliminated resist failures and rejects in the electroplating phase," according to a report from Remington Rand's Supervisor of Chemical Engineering.

This report goes on to say that "AUTRONEX ACID GOLD in printed circuit production offers definite advantages and promotes the highest quality production." Here are some of these advantages proved in Remington Rand's own laboratories:

1. Harder and more wear-resistant surfaces.
2. Elimination of one step in plating cycle — no cyanide gold strike required.
3. Promotes higher bond strength of circuit to dielectric base material by minimizing danger of damaging the adhesive layer.
4. Solder flow through plated holes is definitely better, thereby improving over-all quality.
5. AUTRONEX ACID GOLD has totally eliminated circuit lifting and rejects on boards plated after etching. Formulations used previously attacked the adhesive and undermined the circuit paths.

The conclusion of the report we have been quoting needs no further comment: "We would like to commend the manner in which your company has serviced us in regards to materials, equipment and valuable advice. In many instances your promptness in making equipment and materials delivery has been instrumental in meeting vital production target dates."

The patented AUTRONEX ACID GOLD PLATING PROCESS has production-proved its unique advantages for over two years in the plants of leading manufacturers the world over. AUTRONEX can help *you* make a better, more reliable product—probably at far less cost than with any gold plating formulation you may be presently using. Evaluate AUTRONEX ACID GOLD ELECTROPLATE in your own plant, *on your own product.* We'd be happy to plate sample parts for you at no obligation. Write...wire...or 'phone. We'll make all the arrangements.

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